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## May Measurement Month 2017: Results of 39 national blood pressure screening programmes

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Raised blood pressure is the biggest single risk factor responsible for mortality worldwide. Despite this, the majority of people with hypertension are unaware of having it, are untreated, or are on treatment but uncontrolled. May Measurement Month is a global campaign initiated by the International Society of Hypertension with the aim of raising awareness of high blood pressure. In the first year of the campaign in 2017, over 1.2 million people were screened in 80 countries across the world, finding over 100 000 people with hypertension who were not on treatment and over 150 000 people on anti-hypertensive treatment who were not controlled. The individual national results from 39 countries are presented in this supplement. In this article, we discuss the background to the campaign, along with some of the logistical and methodological challenges that were faced in setting up the campaign, and in collecting and analysing the data from such a large cross-sectional study. With the lessons learned from the 2017 campaign, the campaign was repeated in 2018 and is to be repeated again in 2019.

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## Background

May Measurement Month 2017 (MMM17) was the first of a series of annual campaigns initiated by the International Society of Hypertension (ISH). MMM was created to address the issue of lack of awareness of hypertension, which the PURE study<sup>1</sup> had shown was the single issue with the biggest capacity for improvement in terms of reducing the mortality, morbidity, and burden of disease associated with raised blood pressure (BP). The primary aim of MMM17 was to raise awareness of high BP through a multinational screening campaign and cross-sectional survey of BP in adults across the world.

### MMM17: summary

The methods and results have been fully reported elsewhere<sup>2</sup> but in essence, using convenience sampling and volunteer investigators, three sitting BP measurements of volunteer adults ( $\geq 18$  years) who ideally had not had their BP measured in the previous year, were recorded along with limited data on demographic, lifestyle, and environmental factors. Hypertension was defined as a systolic BP  $\geq 140$  mmHg and/or diastolic BP  $\geq 90$  mmHg, or in those who reported taking anti-hypertensive medication.

Over 1.2 million screenees from 80 countries were included and analysed, of whom about one-third were hypertensive. Among these hypertensives over 100 000 people were not on BP-lowering treatment and over 150 000 people who were on treatment for hypertension had inadequately controlled BP. Thirty-four of the collaborating countries reported that MMM17 was the largest BP screening ever to take place in their country.

### From global to national data

In view of the success of MMM17 at a national level, it was decided to collate the individual national data of those countries who had screened at least 2500 adults, to generate a unique resource of BP data, presented in this *European Heart Journal* Supplement. Table 1 displays an overview of the results for the 39 countries in the supplement, including number of participants, numbers with hypertension, and the proportions of those with hypertension who were untreated, on treatment and uncontrolled and on treatment and controlled. A supplementary table with countries of over 200 participants, not in this supplement, can be found online.

Given a common protocol for the MMM17 campaign, the background and methods of the project are essentially the same across countries but variations in the sources of the convenience samples included, and other logistical issues are apparent and critical to the interpretation of local data. Consequently, we provide keywords which are applicable to all the national papers included.

### Methodological differences

Inevitably, given 39 separate analyses, chance variation from the global findings will occur and it is inappropriate to

carry out some analyses where sample sizes do not permit. Furthermore, the data quality was inadequate in some cases due to logistical problems collecting and recording the data. Not all survey questions were asked in every country, and three BP readings were not universally taken due to local differences in protocol or individual screenee factors.

Our original analysis made use of multiple imputations to impute the mean of the 2nd and 3rd BP reading, where this was missing.<sup>2</sup> The necessity for doing this in drawing comparisons across individuals was underlined by our finding of significant differences among the 1st, 2nd, and 3rd BP readings. Imputations were based on a single BP reading, accounting for the age, gender, and geographical region of the participant. Our previous analyses showed that the biggest determinant of the mean of the 2nd and 3rd readings was a single BP reading. For country-level analyses, we have used the same imputed data from our global study, which may result in an 'averaging' of any country-specific effects. While unique imputations for each country would be ideal, in most cases, there were insufficient data to allow this. Imputation was not possible for all individuals (where either age or gender were missing), so the denominators used in analysis are in many cases less than the total number screened.

Associations of BP with age, gender, and body mass index display a very similar pattern at the country level to those globally. The country papers in this supplement focus on those measures of association which differ to the global results or for which there is particular local interest.

### Challenges to MMM17

Many challenges were faced in the set-up and running of MMM17. From formulating the idea of MMM in September 2016, ISH had 7 months to prepare for MMM17. Critically, would-be national collaborators had to be identified using the International Forum of ISH, the World Hypertension League, National Hypertension or Cardiovascular Societies, the Regional Advisory Groups of ISH and word of mouth. Once identified, these individuals were charged with arranging the logistics at their national level—particularly getting ethical clearance and identifying screening sites and the volunteer workforce.

Several countries experienced delays in being granted ethical approval, which limited the scale of their involvement. Logistical issues were faced with distributing the BP machines kindly donated by OMRON, with customs charges and delivery delays, which again caused local problems for screening sites.

A limited set of questions were asked of each participant. While more data would have generated greater insight, this was balanced against the added time to administer the survey, and a limitation to the number possible to screen. Temperature at the screening site was included, but following an investigator meeting, it became apparent that there were inconsistencies in whether room or outside temperature were recorded, so this was not included in analysis.

**Table 1** Numbers with hypertension and proportion on treatment, controlled and uncontrolled for countries in supplement

Country	Total number	Number with hypertension	Percentage with hypertension	Percentage of individuals with hypertension:		
				Not on medication	On medication and uncontrolled	On medication and controlled
Philippines	271 604	91994	34.3%	31.2%	27.3%	38.3%
China	125 236	32089	25.7%	35.7%	23.0%	41.0%
India *	122 685	38974	31.8%	55.9%	36.4%	7.7%
Indonesia	69 307	23892	34.5%	47.4%	33.0%	19.5%
Taiwan	52 514	28123	53.8%	18.6%	28.9%	52.0%
Sudan	44 413	7332	16.6%	94.9%	2.1%	3.0%
Argentina	32 346	16263	50.4%	24.9%	33.2%	41.5%
Ivory Coast	24 563	5015	20.4%	78.6%	11.6%	9.8%
Colombia	22 258	5036	22.8%	32.5%	19.1%	47.6%
Venezuela	21 645	10584	48.9%	14.5%	28.1%	57.4%
Nigeria	19 904	6709	36.2%	61.7%	21.6%	15.2%
Angola	17 481	6022	34.5%	67.8%	19.2%	13.0%
Cameroon	16 093	4595	29.2%	59.7%	22.8%	17.1%
Kenya	14 847	3647	24.6%	55.4%	20.3%	24.3%
Bangladesh	11 418	5401	47.3%	43.5%	29.5%	27.0%
Viet Nam	10 993	3154	28.7%	47.8%	19.6%	32.5%
Italy**	10 076	3099	30.8%			
Zambia	9 607	2438	25.9%	70.0%	17.9%	11.0%
Armenia	9 199	3114	33.9%	47.0%	40.7%	12.2%
Brazil	7 260	3396	47.0%	27.2%	28.8%	43.2%
Ecuador	6 984	1968	28.2%	22.7%	19.6%	57.7%
United Arab Emirates	6 193	1867	30.2%	43.5%	22.9%	33.6%
Georgia	6 144	3744	60.9%	25.6%	49.7%	24.7%
Nepal	5 972	1456	24.4%	62.4%	17.0%	20.6%
Poland	5 834	2061	35.3%	47.3%	25.8%	26.8%
Russia	5 660	2709	47.9%	27.8%	40.4%	31.8%
Pakistan**	5 333	1880	36.4%			
United Kingdom & Ireland	7 714	3099	40.3%	45.4%	22.0%	32.3%
Chile	4 754	1153	24.3%	56.6%	14.1%	29.3%
Mozambique	4 454	1371	31.1%	80.2%	12.1%	7.5%
Malaysia	4 116	1317	32.4%	36.1%	25.7%	37.6%
Malawi	4 009	849	22.3%	82.1%	9.2%	8.7%
Hungary	3 967	2052	51.8%	26.9%	32.5%	40.5%
Spain	3 849	1923	50.0%	21.2%	26.7%	52.1%
Congo	3 842	1576	41.0%	60.7%	25.9%	13.4%
Australia	3 817	1188	31.2%	49.7%	20.1%	30.1%
South Africa	3 250	795	24.5%	57.7%	19.7%	22.3%
Austria	2 711	1704	62.9%	44.9%	35.0%	20.1%
Cabo Verde	2 630	760	29.0%	30.5%	29.6%	39.1%

\*Note figures for India include only those with all 3 readings available as multiple imputation not used on subset of data from India

\*\*Medication use not recorded, so percentages not on medication and uncontrolled/controlled on medication excluded.

Data collected from around the world came through in various formats, predominantly spreadsheets, which were updated from handwritten entries in the field. Although an online app was available, this was difficult for many study sites to access, and used for only 8% of participants. The use of free-text fields in spreadsheets created a huge amount of work in data cleaning, which was carried out both locally and centrally, with some data unfortunately not possible to salvage. These logistical difficulties resulted in our only being able to lock the database and initiate analyses in January 2018—nominally 7 months after MMM17 ended!

## Limitations

The results presented here are based on a real world, opportunistic screening campaign, and recruitment was not randomized. For this reason, proportions with hypertension should not be taken as the true underlying prevalence but should be viewed within the local context and a reflection of who would *actually* present for screening. Despite this, in reviewing the results reported in this supplement, it is remarkable how often the authors report that the proportion of those found to be hypertensive, those untreated or those uncontrolled on treatment are

similar to other nationally representative samples previously reported.

A further shortcoming is that, by design, as a cross-sectional survey, we do not have data on individual outcomes. Those found to have untreated hypertension, or uncontrolled BP on treatment, were given verbal and written advice that was specific to each country. As we know, dietary and lifestyle changes together can bring about average improvements in systolic BP in the order of 10 mmHg, but we lack data on what happened after advice was supplied. We hope to expand MMM to include a cohort component in some, if not all, countries from 2019 onwards, to allow us to monitor whether intervention resulted in any change for the individual.

### Prospects for the MMM campaign

The success of MMM17 in terms of numbers of countries involved, number of people screened, and number of people detected who had untreated or inadequately treated hypertension made clear that MMM was a pragmatic interim solution to the shortfall of BP screening programmes around the world. As long as volunteer investigators can be found around the world supported by the modest funding involved, MMM should continue on an annual basis.

In 2018, over 1.5 million adults were screened and the data quality was improved in part due to a redesigned spreadsheet template and updated bespoke App which functioned offline/without internet connection. Analyses of these data are complete and the 2019 campaign is in advanced planning stages. Ultimately, we want to use the data generated to influence governments and health policy makers to provide more emphasis and support for BP screening and the prevention and management of raised BP.

### Supplementary material

Supplementary material is available at *European Heart Journal - Supplements* online.

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### References

1. 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.
2. Beaney T, Schutte AE, Tomaszewski 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 screening results worldwide. *Lancet Glob Health* 2018; **6**:e736-e743.