

May Measurement Month: results of 12 national blood pressure screening programmes between 2017 and 2019

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Background

The first May Measurement Month (MMM) campaign, a global blood pressure (BP) screening programme, began in 2017 as an initiative of the International Society of Hypertension.¹ Two subsequent annual campaigns have also been completed in consecutive years^{2,3} and having had to defer activities due to the COVID-19 pandemic in 2020 the fourth campaign was run in 2021, the results of which are currently in press. Since its initiation in 2017, volunteers from more than 100 countries have participated. The aims of MMM have remained consistent from the start—to raise awareness of the importance of the measurement of BP at the individual and population level and to provide a temporary pragmatic solution to the shortfall in BP screening programmes in countries around the world.

Following the publication of the global results of the annual MMM campaigns in 2017 (MMM17),¹ 2018 (MMM18),² and 2019 (MMM19),³ a compilation of individual national publications has followed one year later as European Heart Journal Supplements.⁴⁻⁶ A minimum number of screenees of 2500 was required for each national paper to be included in these original three supplements in order to ensure that the analyses carried out, generated reasonably valid point estimates for each year.

Unfortunately, some countries have taken part in MMM campaigns in 2 or 3 years and fallen short of the prescribed sample size on each occasion. However, when data from each year accumulate for such countries, a reasonable and still contemporary evaluation of the state of hypertension management amongst screenees is generated.

In addition to these individual countries which have reached sufficient numbers of screenees by

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Table 1 Countries participating in the combined supplement of MMM 2017-19

Country	Total participants	Percentage of all participants with hypertension	Percentage of hypertensives aware	Percentage of hypertensives on medication	Percentage of those on medication with controlled BP	Percentage of all hypertensives controlled
Austria	2508	54.6%	67.7%	56.1%	42.0%	23.5%
Benin	2035	35.4%	56.2%	39.7%	34.3%	13.6%
Dominican Republic	3693	57.8%	73.7%	77.1%	38.6%	29.8%
Guatemala	3246	43.4%	74.7%	69.2%	63.1%	43.6%
Kyrgyzstan	2013	9.1%	32.0%	25.0%	54.9%	13.7%
Lithuania	2919	44.8%	79.5%	41.0%	34.8%	14.2%
Mauritius ^a	2303	16.5%	N/A	N/A	N/A	N/A
Niger ^a	2297	33.2%	N/A	N/A	N/A	N/A
Pakistan	25 076	58.7%	79.3%	73.1%	47.3%	34.5%
Paraguay	7782	42.7%	61.8%	49.6%	43.8%	21.7%
Switzerland	3635	32.7%	72.2%	64.6%	60.9%	39.4%
Ukraine	46 549	71.6%	55.9%	82.6%	31.4%	25.9%

^aInformation on awareness and medication use not collected.

accumulating data over 2 or 3 years, some other countries were unable to publish their annual data for one reason or another even though they had screened sufficient participants to be included in previous national supplements. All these countries were invited to publish a short report of their previously unpublished MMM data from 2017 to 2019 and this supplement draws these manuscripts together (*Table 1*).

Although the results arising from MMM campaigns are not based on representative samples of the countries in which they are carried out, they are in many settings the only contemporary national data available to shed light on the state of hypertension management. Hence, the rationale for creating this compilation of national data on BP screening.

May Measurement Month 2017-19: combined summary

Three MMM campaigns have been completed and published to date—MMM17,¹ MMM18,² and MMM19.³

From 2017 to 2019, the MMM questionnaire has varied slightly to include new questions but in the interests of brevity that has meant other questions, initially included, had to be excluded. Nevertheless, the core set of questions has remained largely consistent including demographic and anthropometric data, and a brief medical history including the use of antihypertensive agents.

The key findings of the combined data from these three campaigns include that over 4.2 million adults were screened from over 100 countries,¹⁻³ of whom over 600 000 had untreated hypertension, and over 330 000 were on BP-lowering treatment but were uncontrolled to the now conservative target of <140/90 mmHg.⁷

Consequently, almost 1 million individuals have been detected as having untreated or inadequately treated hypertension during these three campaigns. Even after

age and sex adjustment, there were significant regional differences in rates of hypertension, treatment, and control rates and differences were also apparent between men and women.

However, the proportion of screenees classified as hypertensive, of those on treatment for their hypertension and of those on treatment with controlled hypertension has been relatively consistent across the three campaigns, with approximately one-third of all those screened having hypertension of whom just over one-half were on treatment and about one-third had controlled BP (*Table 2*).

All three campaigns showed a linear association between systolic BP and age and an inverted U-shaped relationship between diastolic BP and age. Equally consistent was the finding of falling BPs with each of the three sitting BPs recorded and that the mean of the second and third readings produced the most conservative (lowest) estimate of hypertension of any single recording or combination of readings.

Clear associations between incremental strata of body weight (expressed as body mass index) and higher levels of BP were apparent, as were higher BP levels amongst those with a higher frequency of alcohol intake and amongst women with a past history of hypertension in pregnancy.

From global to national data

Just as some of the key findings in each MMM campaign varied across regions of the world, further variations within regions and at the national level became apparent. This in part reflects genuine differences between nationalities but may also reflect the impact of opportunistic screening using convenience sampling.

Nevertheless, the MMM data generated in many countries represent the best and/or only available data regarding the status of current hypertension prevalence

Table 2 Comparison of key results from MMM campaigns 2017-19

MMM campaign	Total participants	Percentage of all participants with hypertension	Percentage of hypertensives aware	Percentage of hypertensives on medication	Percentage of those on medication with controlled BP	Percentage of all hypertensives controlled
MMM17	1 201 570	34.9%	N/A	57.8%	53.7%	31.0%
MMM18	1 504 963	33.4%	59.5%	55.3%	60.0%	33.2%
MMM19	1 508 130	34.0%	58.7%	54.7%	57.8%	31.7%

and management in their country. Consequently, three previous supplements including data from 39, 41, and 47 countries in 2017, 2018, and 2019, respectively, have been published.⁴⁻⁶ This current smaller supplement adds to the data previously published in these three supplements by adding data from 12 countries from various combinations of the years from 2017 to 2019. *Table 1* outlines the key MMM results of these 12 countries.

Challenges of the May Measurement Month campaigns

The major challenge for all participating countries in the campaigns completed to date has been raising the finances necessary to complete the work. Whilst in 2017 and 2018, the International Society of Hypertension provided significant central funding; other funds were raised from Servier Pharmaceuticals Co during that time and subsequently to ensure the campaign could continue. The distribution of validated BP measuring devices, kindly donated by OMRON Healthcare has also presented challenges caused by logistical and financial problems and obstacles imposed by various customs regulations.

The completeness of data received in the annual MMM questionnaire has been variable, with some sites not collecting all survey questions and/or missing data for certain fields, although in general data collection has improved between 2017 and 2019. Use of a dedicated MMM app for data collection was available, but logistical challenges and reluctance amongst some investigators to use it in the field has led to the majority of data being collected via paper forms and being transferred to electronic spreadsheets, resulting in lengthy data cleaning processes and delaying publication of results.

Methodological issues

A challenge to comparing and interpreting BP-related estimates both between individuals and between countries or regions relates to missing data in one or more of the BP readings. The MMM protocol stipulated that three BP readings should be taken on all individuals, but three readings were not always provided due to logistical challenges or participant preference. In 2017, 68% of participants had all three readings recorded, rising to 75% in 2018 and 2019. May Measurement Month data have consistently shown a reduction in mean systolic and diastolic BPs from the first, to second, to third readings, which

would lead to an upward bias of hypertension estimates if comparing to participants with only one or two readings. For these reasons, previous analyses have used multiple imputation to estimate the mean of the second and third reading, based on the available BP readings for an individual, and using additional information, where available, including demographics and use of antihypertensive medication. Multiple imputation was based on global data, allowing for an averaging of effects seen at a global level for those countries with numbers too small to run national imputation models. For those national analyses which combined data across multiple years, imputed data were appended using the imputed results run separately for each year, as described in previous papers.¹⁻³ Although this means that imputed data are generated via small differences in the model specifications across years (such as where variables were added or removed between campaign years), previous sensitivity analyses have shown minimal differences in estimates between models, and retains consistency with previous published estimates for each year.

May Measurement Month limitations

The major limitation associated with the MMM campaigns are those associated with insufficient funds to support local investigators in each country to provide the necessary infrastructure to carry out extensive BP screening over an extended period—ideally the full month of May (at least) each year. If needed, all participating sites receive financial support from the MMM central funds to cover the acquisition of ethical clearance and in a few countries small additional sums have been supplied to cover a proportion of local expenses for investigators travel, etc.

Otherwise, local investigators must currently raise funds from local sources to support their campaigns and rely on volunteers to measure the BPs and collect and clean the data. It is remarkable that so many volunteers are prepared to give up their time to collect the enormous amount of data which MMM generates. The amount and type of data which can be collected in MMM are limited by the very reasonable requests of the local investigators to keep the study questionnaire simple and short, otherwise time demands on the volunteers being measured and those measuring the BPs become too great. Similarly, to date we have not included the collection of blood or urine samples or complex

anthropometric measures for the same reasons, compounded by financial implications.

One further shortcoming is the inability to follow-up those screened and who are found to have sub-optimal BP levels. Non-pharmacological advice is provided to all such people and site-specific advice is provided regarding the need for follow-up, but the ability to track follow-up BP measures and the initiation or intensification of antihypertensive therapy in such people is, as yet, beyond the scope of MMM. Such activities have financial and ethical implications, but we expect in future years to formalize an evaluation of at least a sample of the outcomes of those detected with raised BPs.

Although the non-representative nature of the data collected limit the interpretation of the point estimates as prevalence, it is not necessary to include representative samples of the populations surveyed in order to raise awareness of the importance of BP measurement—the primary aim of MMM. To screen representative samples would have huge financial and organizational implications and does not necessarily benefit the key aim of MMM. Furthermore, it is important to appreciate that, particularly given the large number of participants arising from a very wide range of sources around the world, associations with BP investigated in the MMM data set do not have to be based on randomly selected representative samples to be valid.⁸ Finally, the robust associations between measures of BP management from national MMM data and national stroke mortality data vindicate our current strategy of opportunistic screening.⁹

Strengths and prospects for May Measurement Month in 2022 and beyond

May Measurement Month is the largest global standardized compilation of data on BP and indeed on any contemporary cardiovascular risk factor. A common protocol and standardized BP measurement with the vast majority of measurements being recorded with a validated OMRON device provides a unique and valuable database, especially in those countries where no systematic BP screening takes place and where no surveys of representative population samples have been carried out recently.

After deferring MMM activity in 2020 due to COVID-19 but restarting in about half of the usual countries in 2021, MMM has started again in 2022 at full strength, including at least 90 countries.

Meanwhile, it has become increasingly clear that MMM is creating a unique research platform on which to piggy-back related cardiovascular research whilst raising awareness of the biggest contributor to global morbidity and mortality.

Acknowledgements

The MMM programme remains appreciative of the infrastructure and support provided by the International Society of Hypertension to MMM between 2017 and 2020. Our sincere thanks to Judith Bunn (MMM Project Manager 2017-19) but particularly Harsha McArdle who

took over the role in 2020 for helping to create this supplement and taking MMM forward. We also thank Ranjit Rayat (Editing Assistant) for helping to pull this supplement together, several officers of ISH for background support, and OMRON Healthcare and Servier Pharmaceuticals Co for their continued generous contributions. Finally, and critically, we are totally indebted to the thousands of volunteers who ensure that MMM achieves its aims and continues to be a huge success.

Funding

The International Society of Hypertension provided significant core funding for MMM in 2017 and 2018. This has been supplemented since 2018 by a generous annual donation from Servier Pharmaceuticals Co, which has enabled the campaign to happen in 2019 and 2021. However, most of the financial burden of MMM within each country falls on local resources and as ever we are indebted to those who have provided the necessary financial and logistical support within each country and to all those who have volunteered their time to deliver the project. We shall continue to seek further sources of funding to at least offset a greater proportion of the local costs of running MMM. We must also thank OMRON Healthcare for their continued support with their very generous supply of validated BP measuring devices.

Conflict of interest: N.R.P. has received financial support from several pharmaceutical companies which manufacture BP-lowering agents, for consultancy fees (Servier, Aktia), research projects and staff (Servier, Pfizer), and for arranging and speaking at educational meetings (AstraZeneca, Lri Therapharma, Napi, Servier, Sanofi, Eva Pharma, Pfizer, Emcure India, Dr Reddy's Laboratories). He holds no stocks and shares in any such companies. He is the Chairman of the Steering Committee of the TIME trial. C.B., A.D., T.H.J., N.A.K., Y.K., D.P., W.W., T.B. have no conflicts of interest to declare. M.P.S. has received consulting fees, and/or travel and research support (Medtronic, Abbott, Novartis, Servier, Pfizer, and Boehringer-Ingelheim). G.S.S. received consulting and lecture fees (Servier and OMRON). T.U. has received honoraria for lectures and advice during the last 3 years (Boehringer-Ingelheim, ICI, Syntab, Vifor, Cipla-India, and Abbott). A.E.S. received speaker honoraria and/or travel support from Omron, Servier, Takeda, Sanofi, Sun pharmaceuticals, and Abbott. P.M.N. received lecturing fees from Novartis, Novo Nordisk, Boehringer-Ingelheim, and Amgen during recent years. He is a member of a regional advisory group for Sanofi. C.B. has received consulting and/or speaker's fees (Novartis, Servier, Novo Nordisk, Menarini, Alfasigma).

Data availability

Data are not publicly available but are available with permission from the MMM Management Board, on request through the MMM website: maymeasure.org.

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