

MMM 2022 MANUSCRIPT TEMPLATE

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1 **Title:** May Measurement Month 2022: an analysis of blood pressure screening results from Colombia
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8 **Abstract (Maximum of 250 words)**

9

10 The May Measurement Month (MMM) campaign was carried out in Colombia in 2022 with the aim of raising
11 awareness of raised blood pressure (BP). Here, we report on the findings of the campaign. Adults aged ≥ 18
12 years were recruited opportunistically at healthcare and public facilities in eleven departments. Three seated BP
13 readings were taken for each participant, along with completion of a questionnaire on demographics, lifestyle
14 factors, and comorbidities. Hypertension was defined as a systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90
15 mmHg or being on antihypertensive medication. Controlled BP was defined as being on antihypertensive
16 medication with a BP $< 140/90$ mmHg. Multiple imputation was used to estimate any missing BP readings. In
17 total, 38 924 were screened, with a mean age of 46.3 years and 52.9% of whom were female. Of all participants,
18 10 738 (27.6%) had hypertension, of whom 7058 (65.7%) were aware, and 6925 (64.5%) were on
19 antihypertensive medication. Of those on antihypertensive medication, 4600 (66.4%) had controlled BP, and of
20 all participants with hypertension, 42.8% had controlled BP. However, those under 50 years had lower
21 hypertension control ($< 30\%$). Women had a higher BP control than men (49.5 vs 36.3%). High education was
22 associated with lower systolic BP (-2.37 mmHg). The MMM campaign in Colombia identified significant
23 numbers of participants with either untreated or inadequately treated hypertension. MMM22 results point to the
24 need to continue improving awareness and seek a broader implementation of strategies with proven efficacy in
25 controlling hypertension.

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27 Key Words: (6 words maximum)

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1 Hypertension, Blood Pressure, Screening. Treatment, Control.
2

3 **Introduction**

4 Raised blood pressure (BP) is one of the largest contributors to the global burden of disease.¹ In Colombia, the
5 Prospective Urban Rural Epidemiology (PURE) study of community-dwelling adults between 35 and 50 years
6 reported a prevalence of hypertension of 37.7%.² After a 12-year mean follow-up (SD 2.3), the risk of
7 cardiovascular disease (CVD) increased by 25% for every 20 mmHg increase in systolic BP (HR 1.25; 1.12-
8 1.40).² A sub-analysis of PURE in South America (n= 24718), including Colombian individuals, demonstrated
9 that hypertension is the principal modifiable risk factor for CVD and second for general mortality, with a
10 population attributable fraction of 18.7% and 12.0%, respectively.³
11 Colombia participated in MMM in 2017,2018 and 2019. In MMM19, thirteen departments participated, and 48
12 324 BP measurements were taken. The overall percentage of participants with hypertension was 27.9%;
13 approximately two-thirds of participants with hypertension were aware of their condition (63.7%) and were
14 taking BP-lowering medication (60.0%). However, only 38.4% were adequately controlled.⁴ In this paper we
15 report on the findings of the MMM22 campaign in Colombia.

16

17 **Methods**

18 MMM is a cross-sectional opportunistic survey of consenting adults aged 18 years or over. The programme in
19 Colombia was coordinated by the Universidad de Santander (UNDES) over May and September. Screening sites
20 were set up in healthcare facilities such as hospitals and clinics and public spaces in 11 departments of the
21 country (Valle del Cauca, Risaralda, César, Cundinamarca, Nariño, Atlántico, Cauca, Caldas, Santander,
22 Quindío, Norte de Santander). The principal investigator in each department trained volunteers to obtain correct
23 BP measurements following the MMM protocol.⁵ The campaign was advertised via mainstream and social
24 media. A promotional brochure was created to promote the campaign.

25 In accordance with the standard MMM protocol, participants ideally had three seated BP readings measured at
26 one-minute intervals.⁵ OMRON HEM 7120 monitors were used to measure BP. A questionnaire was also
27 completed, collecting information on demographics, comorbidities, lifestyle risk factors and antihypertensive

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2 **Table 1: Total participants and numbers with hypertension, awareness, on medication and with controlled**
3 **blood pressure, before and after age and sex standardisation**

	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
Actual	38 924	10738 (27.6)	7058 (65.7)	6925 (64.5)	4600 (66.4)	4600 (42.8)
Standardised	38 888*	9268 (23.8)	5330 (57.5)	5216 (56.3)	3547 (68.0)	3547 (38.3)

4 * Standardised total lower than actual total, as 36 participants did not have information recorded on age or sex.

5 Compared to females, males were found to have a higher prevalence of hypertension (29.9% vs. 25.6%) but
6 lower awareness (58.3% vs. 73.3%), use of BP-lowering medications (57.4% vs. 71.8%) and percentage of
7 control (36.9% vs. 49.5%). At older ages, the percentage of individuals with hypertension increased (up to
8 60.5% in ≥ 70 years), as well as hypertension awareness (up to 81.5% in ≥ 70 years). However, those under 50
9 years had lower hypertension control, with percentages of control less than 30% (Table 2). Finally, in mixed
10 effects linear regression models adjusted for age and sex (with interaction) and use of BP-lowering medication,
11 having more than 12 years of education was associated with 2.37 mmHg (95% CI: -3.50, -1.24; $p < 0.001$) lower
12 systolic BP on average, compared to having no formal education.

13 **Table 2: Hypertension prevalence and percentages aware, treated, and with blood pressure controlled,**
14 **stratified by age**

Age (years)	Total	Prevalence (%)	Awareness (%)	Medication use (%)	Control (%)
18-29	10 181	7.0%	15.6%	14.8%	11.6%
30-39	6327	11.5%	32.6%	30.1%	19.6%
40-49	5334	22.1%	48.2%	47.2%	29.0%
50-59	5956	34.9%	64.9%	63.8%	43.3%
60-69	5357	47.4%	76.5%	75.1%	51.3%
≥ 70	5769	60.5%	81.5%	80.4%	52.4%

15

16 Discussion

17 The MMM22 programme identified a total of 6138 (15.8%) participants with untreated or inadequately treated
18 hypertension, highlighting the scale of hypertension in Colombia. Of the total 38 924 participants, hypertension

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1 prevalence, awareness, treatment, and control has slightly improved compared to previous years. After four
2 campaigns between 2017 and 2022, including roughly 145 000 measurements, the pooled prevalence of
3 hypertension among opportunistically screened adults in Colombia was 26.2% (22.8%-27.9%). Although there is
4 an improvement in the percentage of hypertension control, it remains less than 45%. While two-thirds of
5 participants with hypertension were aware of their condition, in those under 50 years of age, less than half were
6 aware of their condition, and hypertension control was notably lower in men compared to women. Furthermore,
7 after adjusting for sex, age, and use of BP lowering medication, having more than 12 years of education was
8 associated with a 2 mmHg lower systolic BP compared to having no formal education. Thus, young men with
9 few years of formal education are those that should be considered as a focal group for implementing
10 interventions to improve hypertension control. These individual features associated with lower hypertension
11 control are as described at the baseline of the PURE-Colombia cohort might contribute to explaining the higher
12 CVD rates in men than in women.⁷ Namely, the effect of chronic exposure to high BP over time in men
13 compared to women.

15 **Strengths and limitations**

16 A strength of the MMM campaign is the use of a standardised protocol across countries, which aids
17 comparability of findings. Participants in MMM were recruited opportunistically using convenience sampling
18 and as a result, estimates should not be interpreted as estimates of national prevalence. Hypertension was defined
19 based on three BP readings at a single visit for pragmatic reasons which is not the optimal method of diagnosis at
20 the individual level as recommended in guidelines.⁸ Consequently, the rate of hypertension detected is likely to
21 represent an overestimate.

23 **Conclusion**

24 The MMM22 campaign in Colombia demonstrates that despite individuals with hypertension awareness and
25 medication use being around 65%, hypertension control remains low. These results are driven mainly by those
26 under 50, where medication use, and control are lower compared to older people. Therefore, MMM22 results

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13 **Word Count: 1876**

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