

Supplementary appendix

Title: May Measurement Month: Results of the 2019 Global Blood Pressure Screening Campaign of the International Society of Hypertension.

Authors: Thomas Beaney^{1,2}, Aletta E Schutte^{3,4}, George S Stergiou⁵, Claudio Borghi⁶, Dylan Burger⁷, Fadi Charchar⁸, Suzie Cro¹, Alejandro Diaz⁹, Albertino Damasceno¹⁰, Walter Espeche¹¹, Arun Pulikkottil Jose¹², Nadia Khan¹³, Yoshihiro Kokubo¹⁴, Anuj Maheshwari¹⁵, Marcos J Marin¹⁶, Arun More¹⁷, Dinesh Neupane^{18,19}, Peter Nilsson²⁰, Mansi Patil²¹, Dorairaj Prabhakaran¹⁰, Agustin Ramirez²², Pablo Rodriguez²³, Markus Schlaich²⁴, Ulrike M Steckelings²⁵, Maciej Tomaszewski²⁶, Thomas Unger²⁷, Richard Wainford²⁸, Jiguang Wang²⁹, Bryan Williams³⁰, Neil R. Poulter¹ on behalf of MMM Investigators*.

1. Imperial Clinical Trials Unit, Imperial College London, W12 7RH, UK
2. Department of Primary Care and Public Health, Imperial College London, London W6 8RP, UK
3. Faculty of Medicine, University of New South Wales, George Institute for Global Health, Sydney, Australia,
4. South Africa Medical Research Council, North-West University, Potchefstroom, South Africa
5. School of Medicine, Hypertension Center STRIDE-7 National and Kapodistrian University of Athens Third Department of Medicine, Sotiria Hospital, Athens, Greece
6. Department of Medical and Surgical Sciences, Universita di Bologna, via Albertoni 15, Bologna, Italy
7. Kidney Research Centre, Ottawa Hospital Research Institute, University of Ottawa, 2513-451 Smyth Road, Ottawa, K1H 7N9, Canada
8. Federation University Australia, Ballarat, VIC, Australia

9. Neurology Section, University of Santo Tomas Hospital, Philippines
10. Faculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique
11. Internal Medicine, Hospital San Martin de la Plata, Argentina
12. Centre for Chronic Conditions and Injuries, Public Health Foundation for India,
Gurugram, Haryana, India
13. Faculty of Medicine, University of British Colombia, Vancouver, Canada
14. Department of Preventive Cardiology, National Cerebral and Cardiovascular Centre,
Suita, Japan
15. Department of General Medicine, Babu Banarasi Das University, Lucknow, Uttar
Pradesh, India
16. Hospital Italiano de San Justo, Departamento Clínica Médica, Sección Hipertensión
Arterial, Av. Pte. Perón 2231, CP B1754AZK, San Justo, Argentina
17. Institute of Hypertension, Rural Health Progress Trust, Maharashtra, India
18. Nepal Development Society, Bharatpur-10, Chitwan, Nepal
19. Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins
University, USA
20. Department of Clinical Sciences, Lund University, Skane University Hospital, Malmo,
Sweden
21. Indian Association of Parenteral and Enteral Nutrition, India
22. Hospital Universitario Fundación Favaloro, Buenos Aires, Argentina
23. Hypertension Clinic, Instituto Cardiovascular, Buenos Aires, Argentina-Argentinian
Society of Hypertension.
24. Dobney Hypertension Centre, School of Medicine, Royal Perth Hospital Unit,
University of Western Australia, Perth, WA, Australia

25. Department of Cardiovascular and Renal Research, Institute of Molecular Medicine,
University of Southern Denmark, J.B. Winslows Vej 21-3, 5000 Odense C, Denmark
26. Division of Cardiovascular Sciences, University of Manchester, Manchester, UK
27. CARIM School for Cardiovascular Diseases, Maastricht University, Netherlands
28. Department of Pharmacology and Experimental Therapeutics and the Whitaker
Cardiovascular Institute, Boston University School of Medicine, 72 East Concord
Street, MA02118, Boston, USA
29. The Shanghai Institute of Hypertension, Rujin Hospital, Shanghai Jiaotong University
School of Medicine, Shanghai, China
30. Institute of Cardiovascular Sciences, University College London, London, UK

Corresponding Author:

Professor Neil R. Poulter, Imperial Clinical Trials Unit, Imperial College London, 68 Wood
Lane, London, W12 7RH. Tel: 0207 594 3446 Email: n.poulter@imperial.ac.uk

And Dr Thomas Beaney, Imperial Clinical Trials Unit, Imperial College London, W12 7RH,
UK and

Department of Primary Care and Public Health, Imperial College London, London W6 8RP,
UK.

Tel: 020 7594 3368 Email: t.beaney@imperial.ac.uk

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MMM Investigators

Michael H. Olsen, Kristin T. West-Gustave, Phillip D. Levy, Vivian W.Y. Lee, Kenneth L. Connell, Naima N.H. Hammoudi, Pascal Bovet, Bharathi Viswanathan, Sabine Perl, Bernard K. Kramer, Adrian J.B. Brady, Olulola O. Oladapo, Jephath Chifamba, Dejuma Y. Goshu, Desalew M. Kassie, Sintayehu A. Gebru, Toure A. Ibrahim, Soumana Kabirou, Elham Tavassoli, Mahsa Zolfaghari, Vahideh Yavari, Larysa Mishchenko, Olena Matova, Tetiana Kolenyk, Liliya Zelenenka, Sergiy Fedorov, Maria Dorobantu, Alexandra Paval, Jesse Bittman, Biri Mangat, Sarah Melville, Alexander Leung, Neusa Jessen, Eamon Dolan, Hiroshi N.A. Itoh, Atul Pathak, Laura Garré, José Boggia, Tine L.M. De Backer, Arman S. Postadzhiyan, Osiris V. Valoy-Tiburcio, Angel R. Gonzalez-Medina, Laura G. Valdez-Valoy, Fernando S. Wyss, Erkin Mirrakhimov, Sunil K. Nadar, Vitória V.B. Meira Da Cunha, Ana I. Barrientos, Chukwuemeka R. Nwokocha, Magdalene I. Nwokocha, Zoltán Járαι, Dénes Páll, Dean Picone, Jun Yang, Yook C. Chia, Siew M. Ching, Bertrand F. Ellenga Mbolla, Christian M. Kouala Landa, Dèdonougbo M. Houenassi, Corine Y. Houehanou, Kolawole W. Wahab, Ayodele B. Omotoso, Jose Ortellado, Graciela Gonzales, Luis M. Ruilope, Teresa Gijón, Enrique Rodilla, Ana Molinero, Angela J. Woodiwiss, Ane Orchard, Ruan Kruger, Jana Brguljan, Nina Bozic, Aleksandra O. Konradi, Oxana P. Rotar, Irian Chazova, Tiny K. Masupe, John T. Tlhakanelo, Keneilwe Motlathledi, George Stergiou, Michalis Doumas, Pantelis Zebekakis, Francesco P. Cappuccio, Carolina Barciela, Tricia Tay, Naranjargal Dashdorj, Khulan Tuvdendarjaa, Khatantuul Boldbaatar, Fernando T. Lanas, Maria S. García, Melanie Paccot, Mohammed Ishaq, Saulat Sidique, Feroz Memon, Robert N. Najem, Ali K. Abu Alfa, Samir M.J. Mallat, Jacek J. Jozwiak, Maciej Banach, Piotr Janowski, Betty Twumasi-Ankrah, Gustavus A. Myers-Hansen, Elliot K. Tannor, Mário J. Fernandes, Savarino S. Victória Pereira, Marisa F. Neto, Sudhirsan Kowlessur, Bhooshan Ori, Jaysing Heecharan, Hatem A. Fageh, Hawa A. Derbi, Omar M Msalam, Fastone M. Goma, Charity Syatalimi, Penias Jr Tembo, Musawa Mukupa, Henry L. Ndhlovu, Maureen L. Chirwa, Mary M. Mbeba, Parounak H. Zelveian, Zoya N. Hakobyan, Svetlana V. Gourgenyan, Myeong-Chan Cho, Hae-Young Lee, Jinho Shin, Gianfranco Parati, Guido Grassi, Claudio Ferri, Bezhan Tsinamdzgvrishvili, Amiran Gamkrelidze, Dali Trapaidze, Eduardo C.D. Barbosa, Weimar S. Barroso, Audes M. Feitosa, Myeong-Chan Cho, Hae-Young Lee, Jinho Shin, Vanda M. Azevedo, Luis A. Dias, Glenda N. Garcia, Isaulina Delgado, Genc Burazeri, Gentiana Qirjako, Alban Ylli, Rudina Çumashi, Rafael Hernández-Hernández, Monica L. Gúzman-Franolic, Antonieta P. Costantini-Olmos, José A. Octavio-Seijas, Jesús A. López-Rivera, Igor Morr, Elias Chuki, Tzung-Dau Wang, Wen-Jone Chen, Hung-Ju Lin, Fazila-Tun-Nesa Malik, Sohel R. Choudhury, Mohammad Abdullah Al Mamun, Mir Ishraquzzaman, Ghadeer S. Aljuraiban, Fatima Y. Al Slail, Shatha K. Aldhwailea, Ann A. Badawi, Nguyen L. Viet, Hoang A. Tien, Nguyen T.A. Dong, Cao T. Sinh, Huynh V. Minh, Tran K. Son, Jean-René M'buyamba-Kabangu, Trésor M. Tshiswaka, Fortunat K. Katamba, Nathan B. Buila, Anastase Dzudie, Samuel Kingue, Njume Epie, Armel Njomou, Marie S. Ndom, Afzalhussein M. Yusufali, Nooshin M. Bazargani, Buthaina A. Bin Belaila, Amrish Agrawal, Aisha M. Suhail, Elijah N. Ogola, Bernard M. Gitura, Lilian Mbau, Hellen K. Nguchu, Felix A. Barasa, Enrique A. Gomez, Luis A. Alcocer, Martin Rosas, Silvia Palomo, Alfredo J. Estrada, Patricio Lopez-Jaramillo, Gregorio Sanchez-Vallejo, Maria E. Casanova, Edgar Arcos, Gustavo Aroca, Bhagawan Koirala, Harikrishna Bhattarai, Ghanashyam Pandey, Surya Devkota, Sweta Koirala, Kamal Ranabhat, Pratik Khanal, Tara B. Adhikari, Dolores D. Bonzon, Deborah Ignacia D. Ona, Leilani M. Asis, Benjamin A. Balmores Jr, Rafael C. Castillo, Fortunato García Vásquez, Diego J. Stisman, Walter G. Espeche, Marcos J. Marin, Irene L. Ennis, Xin Chen, Hongyu Wang, Min Liu, Xinhua Yin, Xiaolong Wang, Sandeep Bhalla, Priyanka Gupta, Narsingh Verma, Bal K. Gupta, Shehla Sheikh, Gregoire Wuerzner.



MMM DATA CAPTURE FORM

PLEASE COMPLETE IN BLOCK ONLY CAPITALS, IN BLACK INK AND INSERT ONLY X IN THE CHECKBOX FIELDS



ABOUT THE SCREENING SITE

*1	Country	
*2	City/Town/Village name	
3	Site ID and/or email address	
4	Where is your screening site?	<input type="checkbox"/> Hospital/clinic <input type="checkbox"/> Pharmacy <input type="checkbox"/> Workplace <input type="checkbox"/> Public area (indoors) <input type="checkbox"/> Public area (outdoors) <input type="checkbox"/> Home <input type="checkbox"/> Other
*5	Date of measurement (dd/mm/yy)	/ /

ABOUT THE PARTICIPANT

*6	Please confirm that you understand that the data recorded is anonymous and you give your permission for your readings to be used for academic research purposes	<input type="checkbox"/> Yes <input type="checkbox"/> No
7	Ethnicity** (self-declared)	<input type="checkbox"/> Black <input type="checkbox"/> White <input type="checkbox"/> South Asian <input type="checkbox"/> East Asian <input type="checkbox"/> South-East Asian <input type="checkbox"/> Arabic <input type="checkbox"/> Mixed <input type="checkbox"/> Other
8	When did you last have your blood pressure measured?	<input type="checkbox"/> Never <input type="checkbox"/> Over 12 months ago <input type="checkbox"/> Within the last 12 months
9	Did you participate in May Measurement Month in either 2017 or 2018?	<input type="checkbox"/> Yes <input type="checkbox"/> No
10	Have you ever been diagnosed with high blood pressure by a health professional (except in pregnancy)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
11	Are you currently taking prescribed medication to treat high blood pressure?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
12	If yes to question 11, how many drug classes do you take for your blood pressure?***	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 or more
13	If yes to question 11, do you take a statin?	<input type="checkbox"/> Yes <input type="checkbox"/> No
14	If yes to question 11, do you take aspirin?	<input type="checkbox"/> Yes <input type="checkbox"/> No
*15	How old are you in years? (Estimate if unknown)	<input type="checkbox"/> Mark with X if estimated
*16	What is your sex?	<input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> Other
17	If female, are you pregnant?	<input type="checkbox"/> Yes <input type="checkbox"/> No
18	If female, have you had raised blood pressure in this or a previous pregnancy?	<input type="checkbox"/> Yes <input type="checkbox"/> No
19	Are you currently fasting?	<input type="checkbox"/> Yes <input type="checkbox"/> No
20	Do you have diabetes?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
21	Do you use tobacco?	<input type="checkbox"/> Yes <input type="checkbox"/> No
22	Do you consume alcohol?	<input type="checkbox"/> Never / rarely <input type="checkbox"/> 1-3 times per month <input type="checkbox"/> At least once per week
23	Have you had a heart attack in the past?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know
24	Have you had a stroke in the past?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know

MEASUREMENTS

25	Weight (estimate if not measured)	Kilograms (kg) OR Pounds (lbs)	<input type="checkbox"/> Mark with X if estimated
26	Height (estimate if not measured)	' " Feet & inches OR Centimeters (cm)	<input type="checkbox"/> Mark with X if estimated
27	What is the manufacturer name of the BP device?		
	Systolic Blood Pressure (SBP)	Diastolic Blood Pressure (DBP)	Heart rate
*28	1st measurement		
29	2nd measurement		
30	3rd measurement		

* These questions must be answered in order to be submitted for May Measurement Month

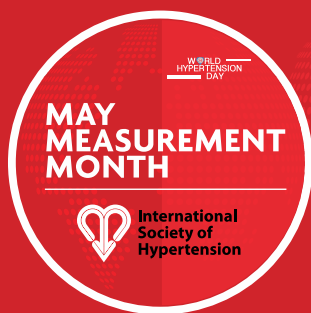
NB: Do not record any personal data that would identify the patient e.g. name, address.

** South Asian – with origins of: India, Pakistan, Bangladesh, Nepal, Bhutan, Maldives and Sri Lanka

East Asian – with origins of: Mainland China, Hong Kong, Macau, Taiwan, Japan, Mongolia, North Korea and South Korea, China, Hong Kong, Japan, Macau, Mongolia, North Korea, South Korea, Taiwan

South-East Asian – with origins of: Cambodia, Laos, Myanmar (Burma), Thailand, Vietnam and Malaysia, Brunei (on the island of Borneo), Indonesia, the Philippines, Singapore and East Timor

*** This means how many types of medications are being taken i.e. – ACE-inhibitors, ARBs, diuretics, beta-blockers, calcium channel blockers, alpha-blockers, others. If you are unsure, please enter the number of different tablets taken each day. (If you are taking 1 tablet twice a day, this counts as 1.) If unknown, please leave blank.



OUR TOP 10 TIPS FOR HEALTHY BLOOD PRESSURE



Keep your weight healthy: just doing this can help bring down high blood pressure



Exercise regularly: aim for an average of around 30 minutes a day. For the exercise to be worthwhile, you need to feel warmer, breathe harder, and your heart needs to beat faster than it normally does



Eat plenty of fruit and/or vegetables every day. Eat vegetables raw or lightly steamed, rather than boiled, to get maximum nutrition. Avoid frying



Add beetroot to your diet: regular consumption of beetroot juice has been found to help bring down your blood pressure



Cut down on salt: don't forget a lot of salt is hidden in processed foods and is very high in most breads, cereals, soups and sauces. If possible, always read the label



Cut down on fat and sugar: always check the label, and be especially wary of hydrogenated or 'trans' fats, as well as sugars 'hidden' as other names such as sucrose, dextrose, fructose, and glucose in e.g. fruit juices and fizzy drinks



Stop smoking tobacco! Your arteries clog up even faster if you smoke and this causes many other health problems. Your blood pressure actually rises while you smoke



Reduce your caffeine intake — and remember caffeine is found in some fizzy drinks as well as in coffee and tea



Don't drink too much alcohol: stick to local daily recommendations — usually less than 2 drinks for men and 1 for women (1 drink = small beer or wine)



Relax: stress contributes to raising blood pressure. So, avoid stress where possible and allow time for relaxation. This can take many forms such as quiet time, socialising, exercising or laughter

Thank you for taking part in May Measurement Month

For further information, visit www.maymeasure.com/public-info

If you have concerns about any of the above, please seek advice from a trained medical professional

A SIMPLE MEASURE TO SAVE LIVES
#checkyourpressure



@maymeasure



www.maymeasure.com

May Measurement Month is an initiative led by the International Society of Hypertension and endorsed by the World Hypertension League

Data cleaning rules

Rules for cleaning continuous variables and dates.

Updated September 2019

Weight (weight and scale variables)

Upper limit: 160.0kg (25.2 stone, 353lbs)

Lower limit: 30.0kg (4.72 stone, 66lbs)

Extract measurement scale from measurement string if missing

Assume recorded in kg if unit of measurement missing

Convert all values to kg, then correct values:

Replace weight/1,000 if weight > 30,000

Replace weight/100 if weight > 3,000

Replace weight/10 if weight > 300

Exclude values > 160 or < 30

Height (height and scale variables)

Upper limit: 213cm (7 feet; 84 inches)

Lower limit: 137cm (4ft6; 54 inches)

Extract measurement scale from measurement string if missing

If no scale recorded:

Assume feet if height ≥ 4.6 and ≤ 7 .

Assume inches if height ≥ 54 and ≤ 84

Assume cm otherwise

If scale recorded:

Correct to feet if height ≥ 4.6 and ≤ 7 and recorded as cm

Convert all values to cm, then correct values:

Replace with height * 100 if height > 1.3 and < 2.2

Replace with height/10 if height > 1,300 and < 2,200

Exclude values > 213 or < 137

Survey date

Assume format DD/MM/YYYY as specified on template

If unclear, assume number 5 or 05 refers to month

Assume months recorded as 'ma' to be May

Correct year to 2019

If month ≥ 9 then switch D & M

Exclude dates where month ≥ 9 or month ≤ 3

Exclude dates where month = 8 and day > 17 (limit to 17th August 2019)

Exclude dates where day ≥ 31 . Exclude day where day=31 in April/June

Age

Upper limit: 99 years (set ages > 99 to missing)

Lower limit: 18 years (drop participants < 18)

For minority of entries recording DOB and not age:

Assume format DD/MM/YYYY or MM/YYYY

Drop day and month if year missing

Drop day where day ≥ 31 . Drop day where day = 31 in April/June

Assume months recorded as 'ma' to be May

Assume day = 15 if day missing and month & year present

Calculate age as survey date – DOB.

If survey date not present then assume survey date 14th May 2019 (for age calculation only)

Set entries with age > 99 to missing
Exclude participants from study if age < 18

Last BP measurement

Never/more than 12 months/within last 12 months

For minority of entries recording date of last measurement:

Assume format DD/MM/YYYY or MM/YYYY

If survey date not present then assume survey date 14th May 2019 (for calculation of time of last BP measurement only)

Systolic blood pressure

Upper limit: 260 mmHg

Lower limit: 80 mmHg

Multiply by 10 entries ≥ 8 and ≤ 26

Remove first digit in entries of format 11XX (assume 1 double-typed)

Divide by 10 entries $\geq 1,200$ & $\leq 2,600$

Exclude entries outside of above range

Diastolic blood pressure

Upper limit: 160 mmHg

Lower limit: 40 mmHg

Multiply by 10 entries ≥ 5 and ≤ 15

Remove first digit in entries of format 11XX (assume 1 double-typed)

Divide by 10 entries ≥ 500 & $\leq 1,500$

Exclude entries outside of above range

Drop SBP and DBP if DBP \geq SBP

Heart rate

Upper limit: 120 bpm

Lower limit: 30 bpm

Multiply by 10 entries ≥ 3 and ≤ 12

Remove first digit in entries of format 11XX

Divide by 10 entries ≥ 300 & $\leq 1,200$

Exclude entries outside of above range

Gender and pregnancy/hypertension in pregnancy

Set pregnancy to missing where gender = 'male' or 'other'

If gender missing and pregnancy/hypertension in pregnancy 'yes', assume gender = 'female'

Known hypertension and medication

Assume known hypertension = 'yes' if medication = 'yes'

Medication status and medication classes

If medication status = 'none' then set medication classes to '0'

If medication = 'yes' and medication classes = '0', set medication classes to missing

If medication classes = 0 and medication status missing, set medication status to 'none'; if medication classes ≥ 1 and medication status missing, set medication status to 'yes'

Statistical analysis

This section gives further detail on the statistical analysis including the multiple imputation models. Data were analysed using Stata version 16.0. Multiple imputation models were run using Stata through the Imperial College High Performance Computing unit.

Multiple imputation

Data on a total of 1,508,130 participants were collected during MMM19, with 75.1% having three BP readings, as shown in Table S1.

Table S1: Number of BP readings per participant

Number of BP readings per participant	Total	Percentage
1	175,453	11.6%
2	199,669	13.2%
3	1,133,008	75.1%

To provide comparable readings across all individuals, including those where three readings were not recorded, we used multiple imputation by chained equations (MICE) which assumed missingness was Missing-at-Random (MAR) and therefore dependent on the observed data only (and not on the unobserved values).

Multiple imputation was conducted using the `mi impute chained` routing in Stata for those with complete data on age, gender (and not equal to other), ethnicity and anti-hypertensive medication status. The complete imputation model included the following variables: gender, age (as a restricted cubic spline with 5 knots), gender by age interaction, ethnicity, anti-hypertensive medication status, known hypertension, previous participation in MMM (2017/2018), last blood pressure measurement, region, country income status, screening site type, height, weight, diabetes, stroke, myocardial infarction, smoking status, aspirin use, statin use, current pregnancy status, previous hypertension in pregnancy, fasting status, day of week, alcohol consumption, along with each of the three systolic BP, diastolic BP and heart rate measurements, and the corresponding mean of the second and third readings.

Therefore, following guidance provided by White et al the imputation model included all variables selected to be in the analysis.¹ Variables which were used to compute the variables within the analysis models (e.g. `sbp1`, `sbp2`, `sb3`, `dbp1`, `dbp2`, `dbp3`, `hr1`, `hr2`, `hr3`) were also included following the just another variable (JAV) approach as described by Seaman et al.² BMI category was passively imputed using the variables height and weight which were included in the imputation model.

A total of 25 imputations were created, corresponding to just over one imputation per percent missing data on the mean of the second and third blood pressure measures (20% missingness). Following imputation we assessed the Monte Carlo error of estimates to confirm this gave adequate precision. The Monte Carlo errors of estimates were <10% of their standard errors indicating sufficient precision.¹ A burn-in of 10 iterations was chosen for each imputation chain meaning that imputed data sets were stored at every 10th iteration of the chain. An assessment of the predicted values from each iteration in a trace plot confirmed this was adequate and chains had converged. Results of analyses on the imputed data were pooled across imputed data sets using Rubin's combination rules.

For individuals missing second and/or third blood pressure reading for whom the mean of second and third systolic blood pressure measurement could not be imputed using the full MI model (due to also missing one or more of age, gender, ethnicity and anti-hypertensive medication status or gender of 'other' recorded) we used a reduced MI model, which included each systolic and diastolic BP reading, along with the mean of the second and third readings only for the primary analysis; sensitivity analysis explored the impact of excluding/alternative missing data assumptions for these individuals (see below). Individuals missing one or more of age, gender, ethnicity and anti-hypertensive medication status were not included in the secondary association analyses.

Sensitivity analyses

For comparison, we present results from the complete case sample and results from the three multiple imputation models. The results are shown in Tables S4 and S5

1. The complete case sample only (those with a mean of blood pressure readings 2 and 3 available).
2. The 'reduced' multiple imputation model which included only blood pressure readings for all.
3. The 'complete' multiple imputation model described above for individuals with complete data on age, gender, ethnicity and anti-hypertensive medication status. Individuals missing second and/or third blood pressure reading for whom the mean of second and third systolic blood pressure measurement could not be imputed using this main MI model (also missing one or more of age, gender, ethnicity and anti-hypertensive medication status) were excluded from the analysis.
4. The 'combined' model, including imputations for individuals from the reduced model, where readings could not be imputed from the complete model (imputation model used for primary analysis).

Measures of association

For analysis of measures of association between systolic and diastolic BP with different risk factors, only participants with imputations from the complete model were used (ie those with complete data recorded on age, sex, antihypertensive medication use, ethnicity, and where gender was not equal to 'other').

Linear mixed models were run separately for systolic and diastolic BP, with the effect of country incorporated in a random intercept model. All models were adjusted for age, sex and antihypertensive medication use, along with an interaction between age and sex. Age was incorporated as a restricted cubic spline with 5 knots, and each spline term was significantly associated with each outcome measure.

For analysis of the association between each BP reading and each heart rate reading, mixed effects models were fitted separately for systolic and diastolic blood pressure, incorporating reading (1,2 or 3) into the model, and adjusting again for age, sex (with an interaction) and antihypertensive medication.

References:

1. White IR, Royston P, Wood AM, Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine*. 2010; 30:4.
2. Seaman SR, Bartlett JW, White IR. Multiple imputation of missing covariates with non-linear effects and interactions: an evaluation of statistical methods. *BMC Med Res Methodology*. 2012;12:46.

Table S2: Mean age, sex distribution and proportion on antihypertensive medication ordered by total participants by region and country

Region and country	Total participants	Percentage	Mean age (SD) in years	Females*	Males*	On anti-hypertensive medication
South Asia	471,302	31.3%	42.7 (15.8)	202,379 (43.0%)	267,590 (56.9%)	59,514 (12.6%)
India	362,708	24.1%				
Nepal	74,205	4.9%				
Bangladesh	24,941	1.7%				
Pakistan	6,919	0.5%				
Sri Lanka	2,043	0.1%				
Afghanistan	486	<0.1%				
East Asia	280,863	18.6%	49.6 (16.5)	148,843 (53.3%)	130,618 (46.7%)	47,060 (16.8%)
China	238,387	15.8%				
Taiwan	24,851	1.6%				
Republic of Korea	9,975	0.7%				
Mongolia	6,522	0.4%				
Japan	979	0.1%				
Hong Kong	149	<0.1%				
Americas	261,676	17.4%	49.5 (18.3)	156,615 (60.0%)	104,368 (40.0%)	75,056 (28.7%)
Argentina	94,523	6.3%				
Colombia	48,324	3.2%				
Mexico	39,700	2.6%				
Venezuela	24,672	1.6%				
Ecuador	15,885	1.1%				
Brazil	13,476	0.9%				
Chile	6,876	0.5%				
Paraguay	4,301	0.3%				
Jamaica	2,550	0.2%				
Honduras	2,394	0.2%				
Peru	2,108	0.1%				
Guatemala	1,812	0.1%				
Dominican Republic	1,810	0.1%				
Uruguay	1,414	0.1%				
Canada	827	0.1%				
El Salvador	516	<0.1%				
Barbados	289	<0.1%				
United States of America	100	<0.1%				
Saint Lucia	99	<0.1%				

Sub-Saharan Africa	177,692	11.8%	40.8 (16.0)	92,921 (52.5%)	84,100 (47.5%)	17,114 (9.6%)
Kenya	33,992	2.3%				
Cameroon	30,187	2.0%				
Democratic Republic of Congo	29,857	2.0%				
Cabo Verde	17,627	1.2%				
Malawi	9,723	0.6%				
Zambia	9,232	0.6%				
Mauritius	8,262	0.5%				
Angola	7,112	0.5%				
Ghana	7,102	0.5%				
Botswana	5,459	0.4%				
South Africa	4,727	0.3%				
Nigeria	3,646	0.2%				
Benin	3,637	0.2%				
Republic of the Congo	3,157	0.2%				
Mozambique	907	0.1%				
Niger	698	<0.1%				
Ethiopia	686	<0.1%				
Zimbabwe	666	<0.1%				
Sierra Leone	524	<0.1%				
Seychelles	315	<0.1%				
Mali	176	<0.1%				
South-east Asia and Australasia	121,767	8.1%	45.2 (16.4)	66,886 (55.1%)	54,493 (44.9%)	36,546 (30.0%)
Philippines	89,941	6.0%				
Vietnam	25,887	1.7%				
Malaysia	3,062	0.2%				
Australia	2,877	0.2%				
Europe	107,608	7.1%	51.2 (17.5)	65,008 (61.3%)	41,079 (38.7%)	30,171 (28.0%)
Albania	19,154	1.3%				
Georgia	13,267	0.9%				
Italy	10,182	0.7%				
Armenia	9,818	0.7%				
Poland	7,072	0.5%				
England	6,350	0.4%				
Greece	5,814	0.4%				
Russia	5,447	0.4%				
Slovenia	4,974	0.3%				
Spain	4,433	0.3%				
Hungary	2,766	0.2%				
Wales	2,365	0.2%				

Portugal	2,247	0.1%				
Kyrgyzstan	2,013	0.1%				
Bosnia and Herzegovina	1,695	0.1%				
Bulgaria	1,596	0.1%				
Belgium	1,570	0.1%				
Switzerland	1,463	0.1%				
France	1,031	0.1%				
Republic of Ireland	961	0.1%				
Romania	766	0.1%				
Ukraine	737	<0.1%				
Lithuania	522	<0.1%				
Scotland	518	<0.1%				
Austria	341	<0.1%				
Germany	341	<0.1%				
Sweden	83	<0.1%				
Denmark	82	<0.1%				
Northern Africa and Middle East	87,222	5.8%	42.7 (15.4)	42,787 (49.2%)	44,103 (50.7%)	15,497 (17.8%)
United Arab Emirates	32,152	2.1%				
Saudi Arabia	25,023	1.7%				
Tunisia	11,271	0.7%				
Libya	8,686	0.6%				
Lebanon	7,019	0.5%				
Oman	2,058	0.1%				
Iran	699	<0.1%				
Algeria	314	<0.1%				
Worldwide	1,508,130		45.8 (17.0)	775,439 (51.6%)	726,351 (48.4%)	280,958 (18.6%)

* 'Other' genders not displayed, so percentages may not add to 100%

Table S3: Participant characteristics globally in MMM 2019

Participant characteristic		Total participants	Percentage including unknown	Percentage not including unknown
Gender	Female	775,439	51.4%	51.6%
	Male	726,351	48.2%	48.4%
	Other	410	<0.1%	<0.1%
	Unknown	5,930	0.4%	
Age (years)	Mean (SD)	45.8 (17.0)		
	18-29	318,471	21.1%	21.3%
	30-39	276,891	18.4%	18.5%
	40-49	272,747	18.1%	18.3%
	50-59	268,918	17.8%	18.0%
	60-69	210,972	14.0%	14.1%
	70 or more	144,868	9.6%	9.7%
	Unknown	15,263	1.0%	
Ethnicity	South Asian	450,597	29.9%	33.7%
	East Asian	285,150	18.9%	21.3%
	Black	153,535	10.2%	11.5%
	South-East Asian	130,230	8.6%	9.7%
	White	128,129	8.5%	9.6%
	Mixed	101,820	6.8%	7.6%
	Arabic	63,654	4.2%	4.8%
	Other	23,697	1.6%	1.8%
	Unknown	171,318	11.4%	
On anti-hypertensive medication	No	1,093,742	72.5%	79.6%
	Yes	280,958	18.6%	20.4%
	Unknown	133,430	8.8%	
Number of anti-hypertensive medication classes	0	1,093,742	72.5%	84.3%
	1	108,165	7.2%	8.3%
	2	67,928	4.5%	5.2%
	3	19,375	1.3%	1.5%
	4	6,519	0.4%	0.5%
	5 or more	1,732	0.1%	0.1%
	Unknown	210,669	14.0%	
Location of screening site	Hospital/clinic	542,977	36.0%	41.6%
	Pharmacy	50,607	3.4%	3.9%
	Public area (outdoors)	388,017	25.7%	29.7%
	Public area (indoors)	137,670	9.1%	10.5%
	Workplace	123,505	8.2%	9.5%
	Other	64,008	4.2%	4.9%
	Unknown	201,346	13.4%	
Participated in MMM 2017/2018	No	955,831	63.4%	75.9%
	Yes	304,101	20.2%	24.1%
	Unknown	248,198	16.5%	
Last BP measurement	Never	518,169	34.4%	40.5%
	More than 12 months	197,440	13.1%	15.4%
	Within 12 months	564,065	37.4%	44.1%
	Unknown	228,456	15.1%	

Aware of hypertension	No	1,079,457	71.6%	76.2%
	Yes	337,027	22.3%	23.8%
	Unknown	91,646	6.1%	
Diabetes	No	1,182,744	78.4%	91.0%
	Yes	116,369	7.7%	9.0%
	Unknown	209,017	13.9%	
Previous MI	No	1,255,349	83.2%	95.8%
	Yes	55,189	3.7%	4.2%
	Unknown	197,592	13.1%	
Previous stroke	No	1,265,949	83.9%	97.2%
	Yes	36,667	2.4%	2.8%
	Unknown	205,514	13.6%	
On aspirin	No	259,945	17.2%	78.4%
	Yes	71,505	4.7%	21.6%
	Unknown	1,176,680	78.0%	
On a statin	No	256,090	17.0%	75.7%
	Yes	82,075	5.4%	24.3%
	Unknown	1,169,965	77.6%	
Pregnant*	No	757,677	97.7%	97.7%
	Yes	17,762	2.3%	2.3%
Hypertensive in previous pregnancy*	No	756,319	97.5%	97.5%
	Yes	19,120	2.5%	2.5%
Fasting	No	1,126,174	74.7%	89.6%
	Yes	130,095	8.6%	10.4%
	Unknown	251,861	16.7%	
Current smoker	No	1,155,959	76.6%	86.3%
	Yes	184,225	12.2%	13.7%
	Unknown	167,946	11.1%	
Alcohol intake	Never/rarely	1,077,117	71.4%	83.1%
	1-3 times per month	136,213	9.0%	10.5%
	Once or more per week	82,726	5.5%	6.4%
	Unknown	212,074	14.1%	
BMI (kg/m^2)	Mean (SD)	25.1 (5.0)		
	Underweight	78,695	5.2%	5.8%
	Healthy weight	667,418	44.3%	49.0%
	Overweight	419,824	27.8%	30.8%
	Obese	196,052	13.0%	14.4%
	Unknown	146,141	9.7%	
Day of week	Monday	179,028	11.9%	13.7%
	Tuesday	206,178	13.7%	15.8%
	Wednesday	206,117	13.7%	15.8%
	Thursday	211,662	14.0%	16.3%
	Friday	228,851	15.2%	17.6%
	Saturday	140,313	9.3%	10.8%
	Sunday	130,367	8.6%	10.0%
	Unknown	205,614	13.6%	
Total participants		1,508,130		

*Proportion of women only

Table S4: Mean BP and corresponding number and proportion of participants with hypertension based on the mean of each reading (of 1,133,008 participants with all 3 readings)

BP reading	Systolic (mmHg)	Diastolic (mmHg)	Number with hypertension	Proportion with hypertension
1	126.0	78.9	426,211	37.6%
2	124.2	77.9	398,035	35.1%
3	122.9	77.1	380,649	33.6%
Mean of 1 & 2	125.3	78.6	401,412	35.4%
Mean of 2 & 3	123.8	77.7	380,067	33.5%
Mean of 1 & 2 & 3	124.4	78.0	381,107	33.6%

Table S5: Number and proportion of participants with a mean BP between each threshold

BP range (mmHg)	Total participants	Proportion of total	Proportion of those with raised BP
Under 120/80	540,983	35.9%	-
120/80 - 129/84	349,685	23.2%	-
130/85 - 139/89	266,636	17.7%	-
140/90 - 149/94	168,127	11.1%	47.9%
150/95 - 159/99	89,544	5.9%	25.5%
160/100 - 169/104	47,751	3.2%	13.6%
170/105 - 179/109	22,351	1.5%	6.4%
180/110 or more	23,052	1.5%	6.6%

Table S6: Mean systolic and diastolic BP comparing complete case to the three imputation models

Imputation model	Number	Mean systolic BP (mmHg)		Mean diastolic BP (mmHg)	
		Estimate	MC error	Estimate	MC error
Complete case	1,136,010	123.7385	-	77.6819	-
Reduced MI model	1,508,130	124.0588	0.000602	77.6859	0.000442
Complete MI model	1,337,820	123.7172	0.000592	77.6373	0.000420
Combined MI model*	1,508,130	124.0542	0.000667	77.6817	0.000485

*Combined MI model is the primary imputation model.

Table S7: Proportions with hypertension comparing complete case to the three imputation models: i) overall ii) proportion with hypertension of those not on antihypertensive medication iii) proportion with uncontrolled blood pressure of those on antihypertensive medication

i)

Proportion with hypertension			
Imputation model	Number	Estimate	MC error
Complete case	1,136,010	0.335359	-
Reduced MI model	1,508,130	0.340715	0.000014
Complete MI model	1,337,820	0.331187	0.000017
Combined MI model*	1,508,130	0.340380	0.000019

ii)

Proportion with hypertension of those not on medication			
Imputation model	Number	Estimate	MC error
Complete case	933,286	0.190989	-
Reduced MI model	1,227,172	0.189773	0.000017
Complete MI model	1,099,415	0.186157	0.000021
Combined MI model*	1,227,172	0.189362	0.000024

iii)

Proportion with hypertension of those on medication			
Imputation model	Number	Estimate	MC error
Complete case	202,724	0.425130	-
Reduced MI model	280,958	0.419357	0.000049
Complete MI model	238,405	0.423223	0.000059
Combined MI model*	280,958	0.421581	0.000052

*Combined MI model is the primary imputation model.

Table S8: Mean BP overall and in those untreated and treated, following multiple imputation using combined model, before and after standardisation for age and sex, worldwide and by region according to WHO world-standard population (of 1,488,854 with age and sex recorded)

Region	Mean BP (mmHg): unstandardised						Mean BP (mmHg): standardised for age and sex					
	Of all participants		Of those not on anti-hypertensive medication		Of those on anti-hypertensive medication		Of all participants		Of those not on anti-hypertensive medication		Of those on anti-hypertensive medication	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
South Asia	124.7	78.9	123.2	78.3	135.4	83.2	124.3	78.7	123.1	78.2	134.4	82.7
East Asia	122.3	74.3	120.0	73.5	133.3	78.2	119.9	73.5	118.8	73.0	130.1	79.8
Americas	124.5	77.4	121.0	76.3	133.2	80.1	122.6	77.3	121.0	76.5	130.3	81.2
Sub-Saharan Africa	124.1	78.6	122.6	77.9	138.1	85.2	124.6	78.8	123.5	78.3	134.5	84.1
South-east Asia and Australasia	121.9	79.6	119.3	78.6	127.7	81.9	121.0	79.3	119.4	78.5	125.2	81.6
Europe	127.8	79.4	123.5	78.0	138.9	83.0	124.4	78.4	122.7	77.7	133.3	82.5
Northern Africa and Middle East	123.4	76.0	121.0	75.1	134.5	79.9	123.0	75.5	121.4	75.0	130.7	78.9
Worldwide	124.1	77.7	121.8	76.9	134.0	81.3	122.9	77.3	121.6	76.7	130.8	81.7

Table S9: Number and proportion of participants with uncontrolled BP by number of antihypertensive medication classes

Number of medication classes	Proportion of those on medication	Number with uncontrolled BP	Proportion with uncontrolled BP
1	53.1%	42,560	39.3%
2	33.3%	30,454	44.8%
3	9.5%	9,281	47.9%
4	3.2%	3,128	48.0%
5 or more	0.9%	770	44.5%

Measures of association

Table S10: Results from linear mixed models comparing mean systolic and diastolic BP in each heart rate category compared to heart rate in the range 40-59 bpm, adjusted for age, sex and antihypertensive medication (n=1,315,669).

Blood pressure	Heart rate (bpm)	Mean BP difference compared to reference heart rate (mmHg)	Standard error	t value	p value	95% confidence interval	
						Lower bound	Upper bound
Systolic	40-59 (reference)	-	-	-	-	-	-
Systolic	60-69	-0.116	0.038	-3.080	0.002	-0.190	-0.042
Systolic	70-79	0.351	0.039	9.000	<0.001	0.275	0.428
Systolic	80-89	1.167	0.040	29.030	<0.001	1.088	1.246
Systolic	90-99	2.138	0.043	49.340	<0.001	2.053	2.222
Systolic	100 or more	3.564	0.053	67.330	<0.001	3.460	3.668
Diastolic	40-59 (reference)	-	-	-	-	-	-
Diastolic	60-69	0.923	0.028	33.380	<0.001	0.869	0.977
Diastolic	70-79	2.222	0.028	78.120	<0.001	2.167	2.278
Diastolic	80-89	3.597	0.029	123.190	<0.001	3.540	3.654
Diastolic	90-99	5.017	0.031	159.880	<0.001	4.956	5.079
Diastolic	100 or more	7.059	0.038	184.490	<0.001	6.984	7.134

Table S11: Results from linear mixed models comparing mean systolic and diastolic BP in those with each condition compared to those without, adjusted for age, sex and antihypertensive medication.

Blood pressure	Co-morbidity	Mean BP difference compared to absence of condition (mmHg)	Monte Carlo error of estimate	Standard error	t value	p value	95% confidence interval		Number in analysis†
							Lower bound	Upper bound	
Systolic	Known hypertension	7.993	0.003	0.077	104.250	<0.001	7.843	8.143	1,356,804
Systolic	Antihypertensive medication*	8.833	0.002	0.041	216.220	<0.001	8.753	8.913	1,357,231
Systolic	Diabetes	1.658	0.004	0.057	29.040	<0.001	1.546	1.770	1,260,921
Systolic	Previous Myocardial Infarction	-0.550	0.004	0.077	-7.170	<0.001	-0.701	-0.400	1,260,312
Systolic	Previous Stroke	-0.315	0.004	0.093	-3.380	0.001	-0.498	-0.132	1,260,160
Diastolic	Known hypertension	4.475	0.003	0.051	88.420	<0.001	4.376	4.574	1,356,804
Diastolic	Antihypertensive medication*	3.714	0.002	0.027	138.110	<0.001	3.661	3.767	1,357,231
Diastolic	Diabetes	-0.315	0.002	0.037	-8.590	<0.001	-0.387	-0.243	1,260,921
Diastolic	Previous Myocardial Infarction	-1.321	0.003	0.050	-26.520	<0.001	-1.418	-1.223	1,260,312
Diastolic	Previous Stroke	-1.190	0.003	0.061	-19.390	<0.001	-1.310	-1.070	1,260,160

* Adjusted for age and sex only. †Variable as dependent on the number of individuals with complete data on each condition.

Table S12: Results from linear mixed models comparing mean systolic and diastolic BP in those with each risk factor compared to those without, adjusted for age, sex and antihypertensive medication.

Blood pressure	Risk factor	Mean BP difference compared to absence of risk factor (mmHg)	Monte Carlo error of estimate	Standard error	t value	p value	95% confidence interval		Number in analysis [†]
							Lower bound	Upper bound	
Systolic	Smokers	1.002	0.003	0.047	21.250	<0.001	0.909	1.094	1,261,437
Systolic	Alcohol:1-3 per month §	1.410	0.003	0.057	24.710	<0.001	1.298	1.522	1,246,142
Systolic	Alcohol: One or more per week §	3.137	0.003	0.068	46.150	<0.001	3.004	3.270	1,246,142
Systolic	Fasting	0.331	0.004	0.056	5.960	<0.001	0.222	0.440	1,251,161
Systolic	Current pregnancy*	-1.092	0.004	0.137	-7.950	<0.001	-1.361	-0.823	705,036
Systolic	Hypertension in previous pregnancy*	3.568	0.004	0.132	27.030	<0.001	3.309	3.826	648,310
Diastolic	Smokers	0.788	0.001	0.030	26.170	<0.001	0.729	0.847	1,261,437
Diastolic	Alcohol:1-3 per month §	0.985	0.002	0.037	26.940	<0.001	0.913	1.057	1,246,142
Diastolic	Alcohol: One or more per week §	1.918	0.002	0.044	43.540	<0.001	1.832	2.004	1,246,142
Diastolic	Fasting	0.181	0.002	0.035	5.130	<0.001	0.112	0.250	1,251,161
Diastolic	Current pregnancy*	-1.305	0.004	0.088	-14.810	<0.001	-1.478	-1.132	705,036
Diastolic	Hypertension in previous pregnancy*	2.600	0.002	0.084	31.070	<0.001	2.436	2.764	648,310

§ Compared with 'never/rare' alcohol use

*Adjusted for age and antihypertensive medication only †Variable as dependent on the number of individuals with complete data on each risk factor.

Table S13: Results from linear mixed models comparing mean systolic and diastolic BP in each BMI category compared to healthy weight, adjusted for age, sex and antihypertensive medication (n=1,342,289).

Blood pressure	BMI category	Mean BP difference compared to healthy weight (mmHg)	Monte Carlo error of estimate	Standard error	t value	p value	95% confidence interval	
							Lower bound	Upper bound
Systolic	Underweight	-2.083	0.003	0.065	-31.880	<0.001	-2.211	-1.955
Systolic	Healthy weight (reference)	-	-	-	-	-	-	-
Systolic	Overweight	2.710	0.002	0.035	77.170	<0.001	2.642	2.779
Systolic	Obese	4.583	0.002	0.046	99.250	<0.001	4.493	4.674
Diastolic	Underweight	-1.107	0.003	0.044	-25.240	<0.001	-1.193	-1.021
Diastolic	Healthy weight (reference)	-	-	-	-	-	-	-
Diastolic	Overweight	1.660	0.001	0.023	72.020	<0.001	1.614	1.705
Diastolic	Obese	3.098	0.002	0.031	99.450	<0.001	3.036	3.159

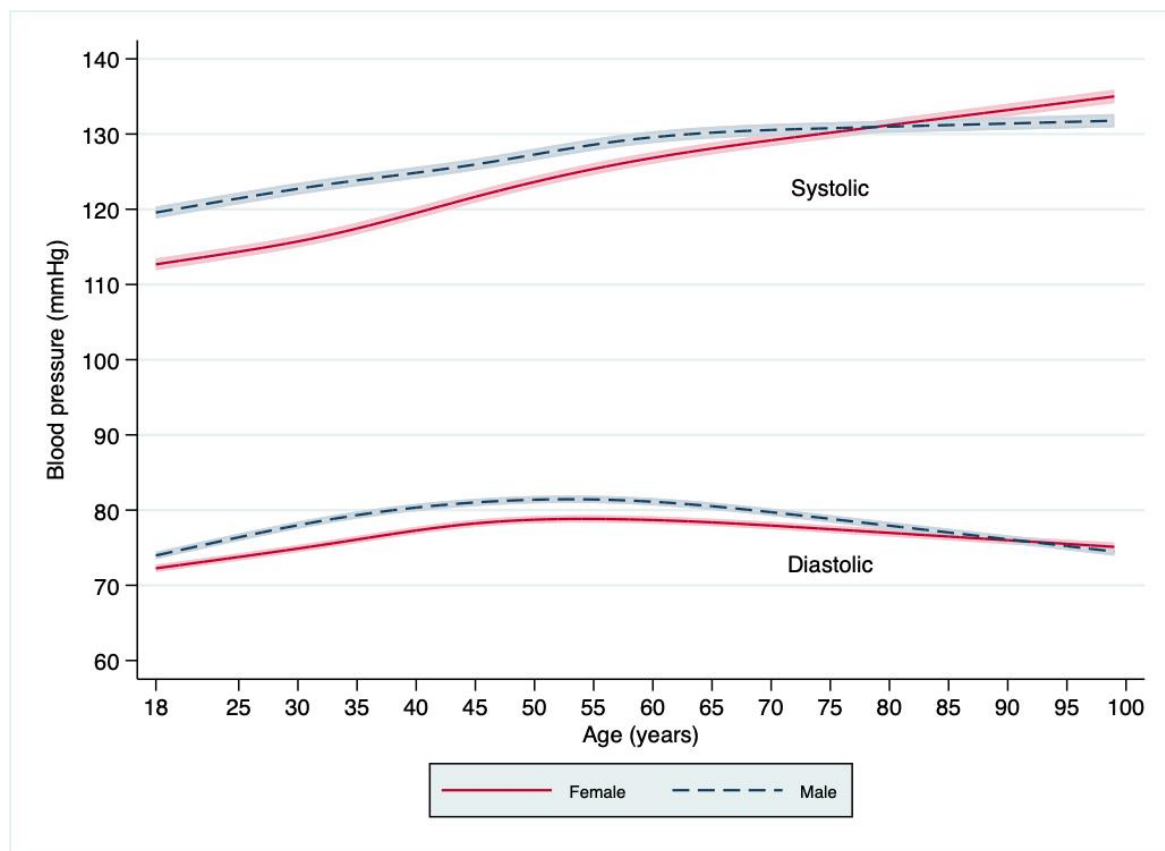
Table S14: Results from linear mixed models comparing mean systolic and diastolic BP in each screening site compared to hospital/clinic, adjusted for age, sex and antihypertensive medication (n=1,249,325).

Blood pressure	Screening site	Mean BP difference compared to hospital/clinic (mmHg)	Monte Carlo error of estimate	Standard error	t value	p value	95% confidence interval	
							Lower bound	Upper bound
Systolic	Hospital/clinic (reference)	-	-	-	-	-	-	-
Systolic	Pharmacy	1.8284	0.0078	0.1173	15.5900	<0.001	1.5983	2.0584
Systolic	Public area (outdoors)	0.7071	0.0020	0.0450	15.7100	<0.001	0.6189	0.7954
Systolic	Public area (indoors)	-0.1996	0.0038	0.0602	-3.3200	<0.001	-0.3177	-0.0816
Systolic	Workplace	0.3051	0.0037	0.0635	4.8000	<0.001	0.1806	0.4296
Systolic	Other	1.8774	0.0049	0.0807	23.2700	<0.001	1.7192	2.0356
Diastolic	Hospital/clinic (reference)	-	-	-	-	-	-	-
Diastolic	Pharmacy	1.4533	0.0058	0.0773	18.7900	<0.001	1.3015	1.6050
Diastolic	Public area (outdoors)	0.1200	0.0016	0.0296	4.0600	<0.001	0.0620	0.1779
Diastolic	Public area (indoors)	-0.5818	0.0017	0.0379	-15.3400	<0.001	-0.6561	-0.5075
Diastolic	Workplace	0.4062	0.0022	0.0408	9.9600	<0.001	0.3262	0.4861
Diastolic	Other	0.7682	0.0028	0.0518	14.8400	<0.001	0.6667	0.8697

Table S15: Results from linear mixed models comparing mean systolic and diastolic BP on each day of the week, compared to Monday, adjusted for age, sex and antihypertensive medication (n=1,261,211).

Blood pressure	Day of week	Mean BP difference compared to Monday (mmHg)	Monte Carlo error of estimate	Standard error	t value	p value	95% confidence interval	
							Lower bound	Upper bound
Systolic	Monday (reference)	-	-	-	-	-	-	-
Systolic	Tuesday	0.242	0.004	0.059	4.130	<0.001	0.127	0.356
Systolic	Wednesday	0.219	0.004	0.058	3.780	<0.001	0.105	0.333
Systolic	Thursday	-0.038	0.003	0.057	-0.670	0.504	-0.150	0.074
Systolic	Friday	-0.046	0.003	0.057	-0.810	0.417	-0.157	0.065
Systolic	Saturday	-0.170	0.003	0.063	-2.690	0.007	-0.294	-0.046
Systolic	Sunday	-0.031	0.004	0.065	-0.480	0.632	-0.159	0.096
Diastolic	Monday (reference)	-	-	-	-	-	-	-
Diastolic	Tuesday	0.255	0.002	0.037	6.950	<0.001	0.183	0.327
Diastolic	Wednesday	0.120	0.002	0.037	3.210	0.001	0.046	0.193
Diastolic	Thursday	0.183	0.002	0.037	4.950	<0.001	0.110	0.255
Diastolic	Friday	0.091	0.002	0.037	2.460	0.014	0.019	0.164
Diastolic	Saturday	-0.022	0.003	0.042	-0.520	0.601	-0.104	0.060
Diastolic	Sunday	-0.054	0.003	0.043	-1.270	0.203	-0.138	0.029

Figure S1: Mean systolic and blood pressure by age and sex from linear mixed models, in participants not taking antihypertensive medication



Note: shaded area represents 95% confidence interval of estimate

Figure S2: Difference in mean systolic and diastolic BP (with 95% CI) by heart rate category compared to heart rate <60 bpm, from linear mixed models adjusted for age, sex and antihypertensive medication

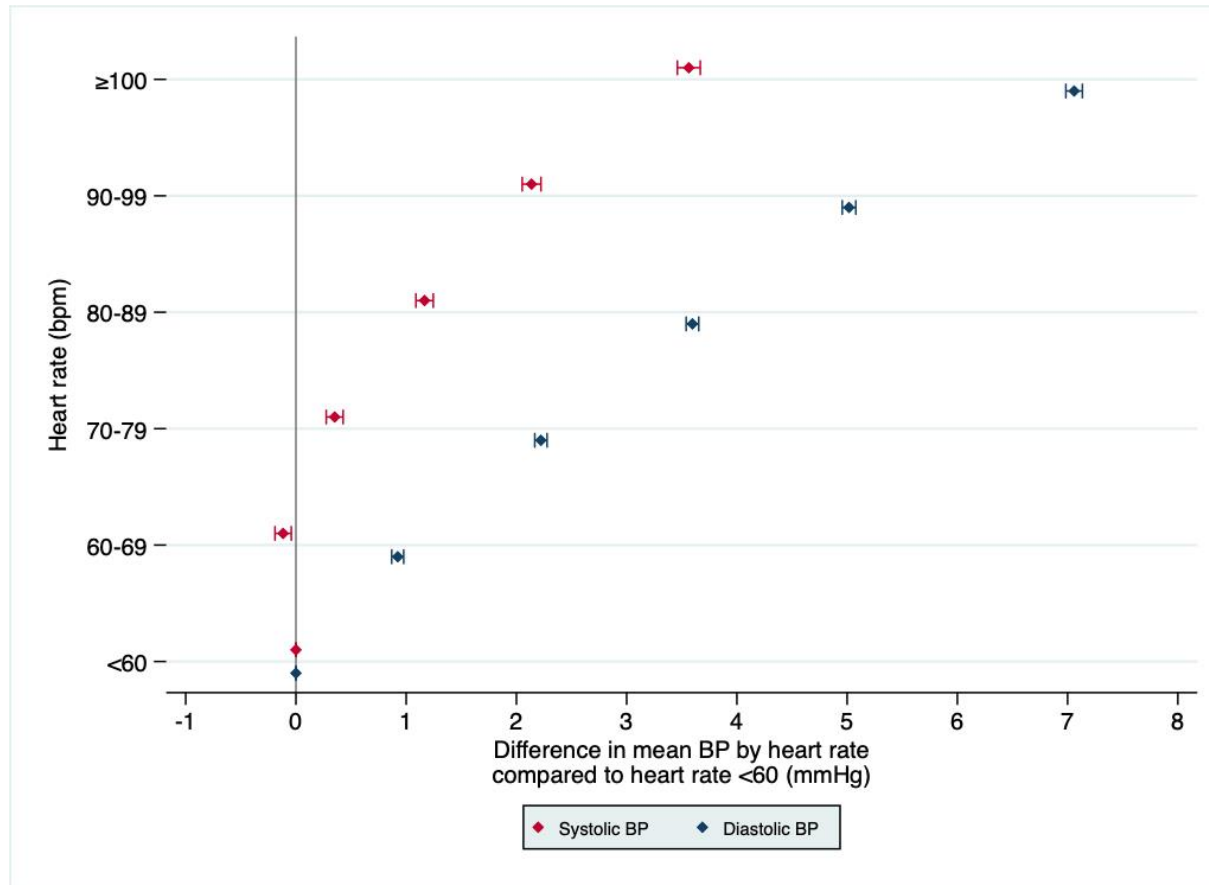


Figure S3: Difference in mean systolic and diastolic BP (with 95%CI) by screening site compared to hospital/clinics, from linear mixed models adjusted for age, sex and antihypertensive medication

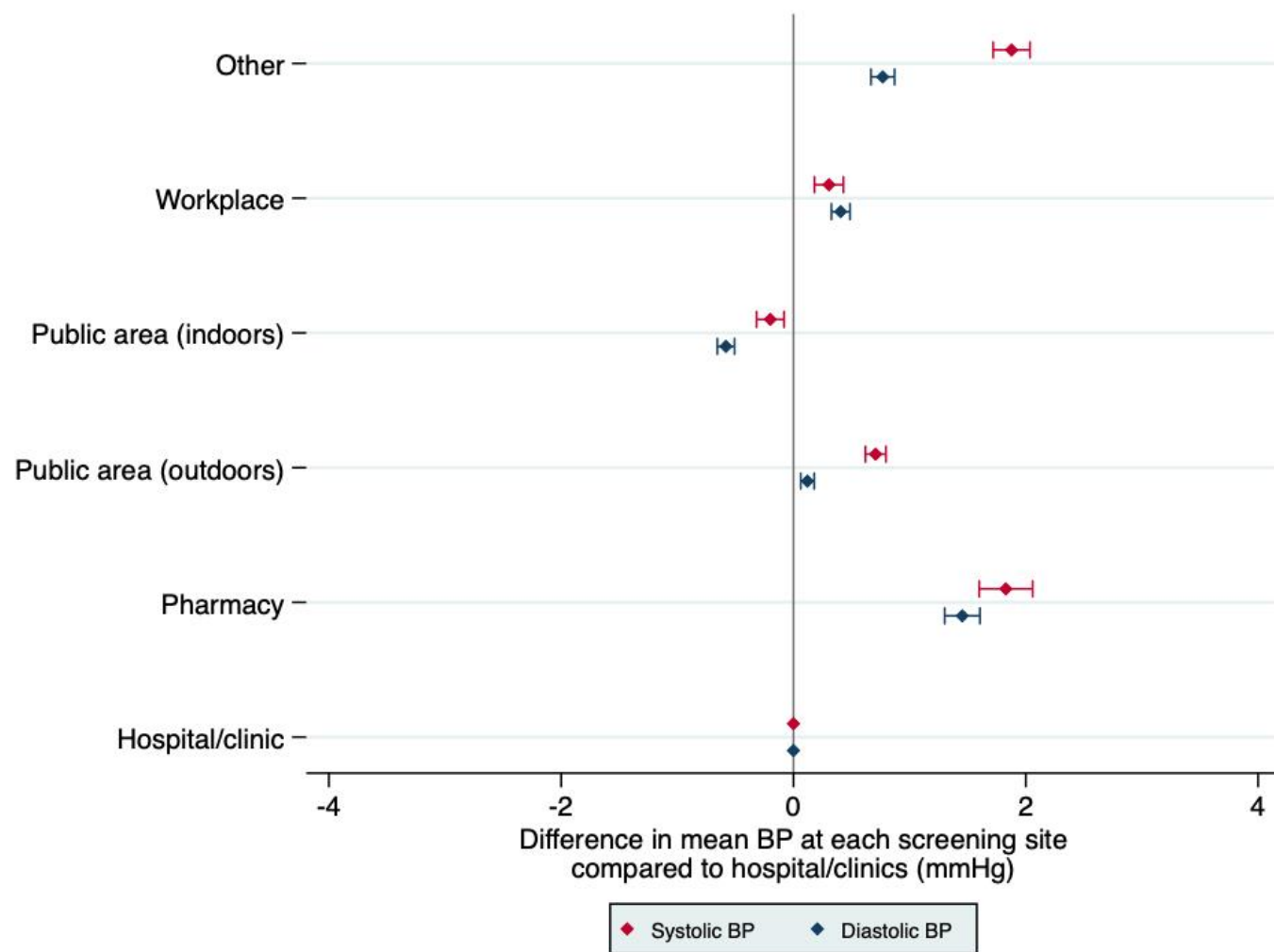


Figure S4: Difference in mean systolic and diastolic BP (with 95%CI) by day of the week compared to Monday, from linear mixed models adjusted for age, sex and antihypertensive medication

