**Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1,201 population-representative studies with 104 million participants**

NCD Risk Factor Collaboration (NCD-RisC)

**Summary**

**Background:** Hypertension can be detected at the primary health care level and low-cost treatments can effectively control hypertension. Our aim was to measure the prevalence of hypertension, and progress in its detection, treatment and control from 1990 to 2019 for all countries.

**Methods:** We used data from 1990 to 2019 on people aged 30-79 years from population-representative studies with measurement of blood pressure and data on blood pressure treatment. We defined hypertension as having systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg, and/or taking medication for hypertension. We applied a Bayesian hierarchical model to estimate the prevalence of hypertension and the proportion of people with hypertension who had a prior diagnosis (detection), who were taking medication for hypertension (treatment), and whose hypertension was controlled to below 140/90 mmHg (control). The model allowed for trends over time to be non-linear and to vary by age group.

**Results:** The number of people with hypertension doubled from 1990 to 2019, to 626 (95% credible interval 584-668) million in women and 652 (604-698) million in men in 2019. In 2019, age-standardised hypertension prevalence was lowest in Canada and Peru for both men and women; in Taiwan, South Korea, Japan and some countries in western Europe including Switzerland, Spain and the UK for women; and in a number of low- and middle-income countries such as Eritrea, Bangladesh, Ethiopia and Solomon Islands for men. Hypertension prevalence surpassed 50% for women in two countries and men in nine countries, in central and eastern Europe, central Asia, Oceania, and Latin America.

Globally, 59% (55-62) of women and 49% (46-52) of men with hypertension reported a prior diagnosis of hypertension in 2019, and 47% (43-51) and 38% (35-41) were treated, respectively. Control rates among people with hypertension were 23% (20-27) for women and 18% (16-21) for men. In 2019, treatment and control rates were highest in South Korea, Canada and Iceland (treatment >70%; control >50%), followed by the USA, Costa Rica, Germany, Portugal and Taiwan. Treatment rates were less than 25% for women, and less than 20% for men, in some countries in sub-Saharan Africa and Oceania, Nepal and Indonesia. Control rates were below 10% for women and men in these countries, and for men in some countries in north Africa, central and south Asia, and eastern Europe. Treatment and control rates have improved in most countries since 1990, but there was little change in most countries in sub-Saharan Africa and Oceania. Improvements were largest in high-income countries, central Europe and some emerging economies and middle-income countries including Costa Rica, Taiwan, Kazakhstan, South Africa, Brazil, Chile, Turkey and Iran.

**Interpretation:** Improvements in detection, treatment and control of hypertension have varied substantially across countries, with some middle-income countries now outperforming most high-income nations. The dual approach of reducing hypertension prevalence through primary prevention and enhancing its treatment and control is achievable not only in high-income countries but also in low- and middle-income settings.

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**Research in context**

*Evidence before this study*

We searched MEDLINE (via PubMed) for articles published from inception to Jan 15, 2021, using the search terms ((hypertension[Title] AND (((medication OR treatment) AND control) OR aware\*) AND “blood pressure”) OR (cardiovascular[Title] AND risk factor\*[Title] AND “blood pressure” AND (((medication OR treatment) AND control) OR aware\*))) AND (trend\* OR global OR worldwide) NOT patient\*[Title]. No language restrictions were applied.

We found a few multi-country studies that reported hypertension prevalence, treatment and control. These studies used up to 135 data sources that had sampled from national or subnational populations or data from small communities. Few multi-country studies reported trends over time. The largest of these analyses covered snapshots in 2000 and 2010 and grouped countries into high-income and low- and middle-income. We also found a number of studies that analysed trends in individual countries. To our knowledge, there is no study on long-term trends in, nor the contemporary levels of, hypertension prevalence, detection, treatment and control that covers the entire world.

*Added value of this study*

To our knowledge, this study is the first comprehensive global analysis of trends in hypertension prevalence, detection, treatment and control that covers all countries in the world. The data used in the study were from 184 countries, together covering 99% of the global population, and were subject to rigorous inclusion and exclusion criteria. Data were analysed using a standardised protocol and were pooled using a statistical model designed to incorporate how hypertension and its care and control vary in relation to age, geography and time.

*Implications of all the available evidence*

Hypertension care – including detection, treatment and control – varies substantially throughout the world and even within the same region of the world. Sub-Saharan Africa, Oceania and south Asia currently have the lowest rates of detection, treatment and control, and many countries in these regions have seen little improvement in these outcomes over the past 30 years. The large improvements observed in some emerging economies and middle-income countries demonstrate that it is possible to leverage the expansion of universal health coverage and primary care to enhance hypertension care and reduce its health burden.

**Introduction**

Hypertension, along with pre-hypertension and elevated blood pressure, is responsible for 8.5 million deaths from stroke, ischaemic heart disease, other vascular diseases and renal disease throughout the world.1,2 Hypertension can be detected in the community and primary care facilities, and a number of effective drugs are available at relatively low cost for treating hypertension and reducing the risk of its sequelae.1,3-5 Improving the effective coverage of hypertension treatment is an objective of many global, regional and national initiatives and programmes.

Comparable data on hypertension detection, treatment and control are needed to learn from good practice to guide health system programmes. There are currently no comparable global data to evaluate which countries have high versus low rates of detection, treatment and control, and how these have changed over time (Research in Context Panel). We present consistent national, regional and global estimates of trends in hypertension prevalence, detection, treatment and control from 1990 to 2019.

**Methods**

*Primary outcomes*

Our primary outcomes were: prevalence of hypertension, and the proportion of people with hypertension who reported a prior hypertension diagnosis (detection), who were taking medication for hypertension (treatment) and whose blood pressure was controlled (control).6 Hypertension was defined as having systolic blood pressure (SBP) ≥140 mmHg, diastolic blood pressure (DBP) ≥90 mmHg, and/or taking medication for hypertension. Control was defined as taking medication for hypertension and having SBP <140 and DBP <90 mmHg. We also report the proportion of people with hypertension who had undiagnosed or untreated stage 2 hypertension (SBP ≥160 and/or DBP ≥100 mmHg). We restricted our analysis to men and women aged 30 to 79 years, because hypertension prevalence is relatively low before 30 years, and because guidelines differ in thresholds and treatment targets in older ages.7

*Data sources*

We used data from 1990 to 2019 collated by the NCD Risk Factor Collaboration (NCD-RisC), as detailed previously8 and summarised in Appendix Text 1. The inclusion criteria were: (1) data were collected using a probabilistic sampling method with a defined sampling frame; (2) data were from population samples at the national, sub-national (covering one or more sub-national regions), or community (one or a small number of communities) level; (3) SBP and DBP were measured; (4) data on hypertension treatment were available.

Studies were excluded if they (1) included or excluded participants based on health status; (2) were conducted only among ethnic minorities or specific educational, occupational, or other socioeconomic subgroups; (3) recruited participants through health facilities, except studies whose sampling frame was health insurance schemes in countries where at least 80% of the population were insured, and studies based on primary care system in high-income and central European countries with universal insurance; or (4) had not measured blood pressure. A list of data sources and their characteristics is provided in Appendix Table 1.

We established whether a participant had been diagnosed with hypertension using questions worded as a variation of “have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?”. We determined whether a person was taking medication for hypertension using questions worded as variations of “Are you currently taking any medicines, tablets or pills for high blood pressure?” or “In the past two weeks, have you taken any drugs (medication) for raised blood pressure prescribed by a doctor or other health worker?”. In studies that gathered information on prescribed medicines, we used survey information to establish that the purpose of taking a blood-pressure-lowering drug was specifically to treat hypertension.

We used 1,201 studies carried out from 1990 to 2019 with data on 104 million participants aged 30-79 years. Of these, 986 studies also had information on prior diagnosis. A total of 184 countries, covering 99% of the global population, had at least one data source (Figure 1); 131 countries, covering 94% of the world’s population, had two or more data sources. Regionally, data availability ranged from 2.2 data sources per country in sub-Saharan Africa to 26 data sources per country in the high-income Asia Pacific region.

*Statistical analysis*

We calculated the prevalence, detection, treatment and control of hypertension by sex and age group for each study. The denominators for detection, treatment and control were the number of people with hypertension. When applicable, we used survey sample weights and accounted for complex survey design.

We applied a Bayesian hierarchical model to these sex-age-specific data to estimate the aforementioned primary outcomes by country, year and age. All analyses were performed separately by sex and for each primary outcome. The model is described in detail in a statistical paper9 and related substantive papers8,10 and summarised in Appendix Text 2. Countries were grouped into 21 regions, which were further grouped into 9 super-regions (Appendix Table 2). In the hierarchical model, estimates for a country-year were informed by its own data if available, by data from other years in the same country, and from other countries, especially those from the same region and super-region. The extent to which estimates for each country-year were influenced by data from other years and countries depended on whether the country had data, sample size, whether data were national, and the within-country and within-region variability of the available data.

The model allowed for non-linear time trends and non-linear age patterns. For this analysis, we adapted the model to allow time trends to vary by age (Appendix Text 2) because how hypertension and its detection, treatment and control have changed over time depends on age.11,12 The model also accounted for the possibility that hypertension prevalence, detection, treatment and control rates in sub-national and community studies might systematically differ from nationally representative studies, and/or might have larger variation than national studies, so that national data had larger influence on the estimates than sub-national or community data with similar sample sizes. Finally, the model accounted and adjusted for how much studies that were done in only rural or urban areas differed from national studies.

We fitted the model using the Markov chain Monte Carlo (MCMC) algorithm implemented in R programming language, and obtained 50,000 post-burn-in samples from the posterior distribution of model parameters. We kept every 10th sample, and the resultant 5,000 samples were used to obtain the posterior distributions of the primary outcomes. The reported 95% credible intervals are the 2.5th-97.5th percentiles of the posterior distributions. We calculated age-standardised hypertension prevalence, and the rates of detection, treatment and control, by weighting age-specific estimates using the WHO standard population.13 When calculating age-standardised detection, treatment and control rates, we also accounted for the age pattern of hypertension prevalence, which appears in the denominator, by using the combination of WHO standard population weights and age-specific hypertension prevalence to weight age-specific estimates. Estimates for regions, super-regions and the world were calculated by weighting the age-sex-specific posterior samples for the constituent countries with the corresponding age-sex-specific national populations; the population data were from World Population Prospects (2019 revision).14 The estimates in each country and region and in each year are for the corresponding national and regional population in that year. We used consistent analysis and presentation units over the entire 30-year period. For countries that were formed during these 30 years (e.g., South Sudan and Montenegro), estimates apply to an equivalent territory for the years before their formation.

*Role of funding source*

The funders of the study had no role in the design or conduct of the study, including data collection, management, analysis, or interpretation of the results; preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication. The corresponding author had final responsibility for the decision to submit for publication.

**Results**

*Hypertension prevalence*

In 2019, global age-standardised prevalence of hypertension in adults aged 30-79 years was 32% (95% credible interval 30-34) in women and 34% (32-37) in men, similar to 1990 levels of 32% (30-35) in women and 32% (30-35) in men. The stable global prevalence was a net effect of a decrease in high-income countries, and for women also in central and eastern Europe, and an increase in some low- and middle-income countries. The decline was >12 percentage points in women in Germany, Spain and Japan and men in Germany, Switzerland, UK, Finland and Canada (posterior probability, PP, of the observed decline being a true decline >0.98 for all country-sex combinations). By contrast, age-standardised prevalence increased, or at best remained unchanged, in most low- and middle-income countries. The increase was 10-12 percentage points among men in Uzbekistan, Argentina and Paraguay, and women in Kiribati, Tonga, Tuvalu and Indonesia (PP 0.85-0.99).

Nationally, prevalence of hypertension in 2019 was lowest in Canada and Peru for both men and women; in Taiwan, South Korea, Japan and some countries in western Europe, including Switzerland, Spain and UK, for women; and in some low- and middle-income countries like Eritrea, Bangladesh, Ethiopia and Solomon Islands for men. Age-standardised prevalence in all of these countries was <24% for women and <25% for men in 2019 (Figure 2). Hypertension prevalence was highest throughout central and eastern Europe, central Asia, Oceania, southern Africa and some countries in Latin America and the Caribbean. For women in two countries and men in nine countries, age-standardised prevalence surpassed 50%.

*Hypertension detection, treatment and control*

Globally, 41% (38-45) of women and 51% (48-54) of men with hypertension did not report a prior diagnosis. Treatment rate was 47% (43-51) in women and 38% (35-41) in men. Less than one half of those treated had achieved hypertension control, leading to global control rates of 23% (20-27) for women and 18% (16-21) for men with hypertension (Figure 3). 27-34% of women and men in the high-income western and Asia Pacific regions with hypertension were not aware of their condition; an additional 10-14% were untreated; and 21% did not achieve control (Figure 3). The detection gap, together with sequential low treatment coverage and effectiveness, led to control rates ranging from 31% in men in the high-income Asia Pacific to 43% in women in the high-income western region. Control rates were below 13% in sub-Saharan Africa and Oceania, where nearly 60% of women and 70% of men with hypertension were not aware of their condition; detection, treatment and control rates in south Asia were only slightly higher. In all regions the coverage of treatment increased with age, being highest in those aged ≥65 years (Appendix Figure 1).

Nationally, hypertension treatment and control were highest in South Korea, Canada and Iceland, where >70% of women and men with hypertension were treated and over one half had their hypertension controlled (Figure 4). Treatment and control rates were also high in USA, Costa Rica, Germany, Portugal and Taiwan. At the other extreme, treatment rates were <25% for women, and less than 20% for men, in a number of countries in sub-Saharan Africa and Oceania, Nepal and Indonesia. Control rates were <10% for women and men in these countries, and for men in some countries in the Middle East and north Africa, central and south Asia, and eastern Europe. The proportion of those treated who achieved control varied by more than three folds across countries (Appendix Figure 2). In particular, many countries in eastern Europe, central and east Asia, and the Middle East and north Africa had relatively high treatment rates but low control, contrasting with high-income countries and some countries in Latin America and the Caribbean, where treatment and control tracked more closely (Appendix Figure 3).

Hypertension treatment and control improved in most countries since 1990, but there was little improvement in many countries in sub-Saharan Africa and Oceania (Figure 4). Improvements were largest in high-income countries and central Europe, with some countries like Canada, Germany, Iceland, South Korea and Poland expanding treatment and control by >30 percentage points. Some emerging economies and upper middle-income countries (e.g., Costa Rica, Taiwan, Kazakhstan, South Africa, Brazil, Chile, Turkey and Iran) also substantially enhanced treatment and control. Hypertension treatment and control rates were lower in men than in women in most countries (Appendix Figure 4). The male disadvantage in treatment was smaller in high-income countries than elsewhere, and in a few, there was a reversal of this pattern.

In 2019, the proportion of people with hypertension who had stage 2 hypertension but were not diagnosed or treated was below 10% in countries with high treatment coverage, and as low as 4% among women in South Korea (Figure 5). At the high end, between one in four to one in three women and men with hypertension in many sub-Saharan African countries and in some countries in central, south and southeast Asia had stage 2 hypertension but were not diagnosed or treated.

*Number of people with hypertension and unmet treatment need*

Despite stable prevalence, the absolute number of people aged 30-79 years with hypertension doubled from 331 (306-359) million women and 317 (292-344) million men in 1990 to 626 (584-668) million women and 652 (604-698) million men in 2019 due to population growth and ageing (Figure 6). Similarly, despite improvement in detection, treatment and control rates, more people did not achieve effective control in 2019 than in 1990 because of the large rise in the number of people with hypertension.

In high-income western and Asia Pacific regions, and in central and eastern Europe, the opposite effects of declining prevalence and population growth and ageing led to a small net increase in the number of people with hypertension. The improvements in treatment and control from 1990 to 2019 shifted many of those with hypertension in these regions from being untreated to being treated and having their hypertension controlled. These improvements lowered the absolute number of those who were not treated or whose hypertension was not effectively controlled.

In 2019, over one billion people with hypertension (82% of all people with hypertension in the world) lived in low- and middle-income regions. This was much larger than the number in 1990, because prevalence remained unchanged or increased, and the population grew and became older. In sub-Saharan Africa, Oceania and south Asia, the majority of the increase was in those without a prior diagnosis, whereas in east and southeast Asia and Latin American and the Caribbean the number of people in this category increased slightly through mid-2000s before flattening; since then, many more of those with hypertension have been detected, treated and controlled (Figure 6).

**Discussion**

Our novel comprehensive analysis of hypertension prevalence and care has shown that since 1990 the number of people with hypertension in the world has doubled with the majority of the increase taking part in low- and middle-income regions. In high-income countries, prevalence has declined while health systems have achieved treatment and control rates of up to 80% and 60%, respectively. Middle-income countries in Latin America, east and southeast Asia, and central Asia, the Middle East and north Africa, have also enhanced the detection and treatment of hypertension; some, like Costa Rica, now outperform most high-income nations in hypertension treatment and control. Low detection and treatment rates persist in the world’s poorest nations, especially in sub-Saharan Africa, Oceania and south Asia. Together with the rising number of people who have hypertension, this will shift an increasing share of the burden of vascular and renal conditions to these regions.

*Comparison with other studies*

To our knowledge, no prior study of trends in hypertension prevalence, detection, treatment and control covers all countries in the world. Our results are consistent with a multi-country study that reported for 2000 and 2010,15 in terms of higher treatment and control in high-income countries than low- and middle-income countries, but our national results show that there is substantial variability at any level of economic development, with some upper middle-income countries having treatment and control rates as good as, or better than, some high-income countries. The findings of a study on 44 low- and middle-income countries16 were consistent with ours in terms of hypertension treatment being highest in Latin America and lowest in sub-Saharan Africa; this study did not have data on trends or from high-income countries. Our finding on variable improvement in hypertension treatment in high-income countries is consistent with a previous multi-country study.12

*Strengths and limitations*

The strengths of our study include its scope of presenting consistent and comparable global estimates of hypertension prevalence, treatment and control, the scale and quality of data which were harmonised in a rigorous process, and the statistical methods that were designed for analysing trends in the hypertension treatment cascade. We used data from >1,200 studies in 184 countries, covering 99% of the world’s population, which is eight times as many studies as the previous largest analysis.15 We used only data from studies that had measured blood pressure to avoid bias in self-reported data. We re-analysed data according to a standardised protocol and the characteristics and quality of data were rigorously verified through repeated checks by NCD-RisC members. We used a statistical model that accounted for heterogeneous trends by age in hypertension prevalence, detection treatment and control, and we used all available data, while giving more weights to national data than to non-national sources.

Similar to all global analyses, our study has some limitations. Despite our extensive efforts to identify and access data, some countries, especially those in Oceania and sub-Saharan Africa, had less data than in other regions. Most health surveys collect data on prior diagnosis and treatment of hypertension using a questionnaire, which may have an error. Validation studies show that recall of hypertension diagnosis and medication has good agreement with actual medical history (e.g., with Cohen’s kappa ranging between 0.55 and 0.91).17-20 Mercury sphygmomanometers were more common in earlier studies whereas most recent studies often used digital oscillometric devices. Similarly, studies differed on whether they used multiple cuff sizes or one cuff size or whether they measured blood pressure more than once. The effect of measurement device and protocol on population prevalence depends on the circumstances of each study. For example, an automated digital device with a standard cuff, although not the traditional gold-standard in a clinical setting, avoids observer bias and increases compliance, and possibly even response rate, compared with a mercury sphygmomanometer with multiple cuffs.21 Nonetheless, measurements from different devices are not fully comparable. Most health surveys are based on one visit to each participant, during which blood pressure is measured multiple times, usually after a resting period when interviews are carried out. Some studies have found that hypertension prevalence based on data collected in multiple visits was lower than those based on one visit.22 We had limited comparable data on treatment details such as the type of drugs, because these data are not consistently collected in population-representative surveys. Complementing survey data with data from health facilities or prescriptions could provide such clinically relevant details.

*Implications for hypertension prevention and management*

Our country results show that it is feasible to both prevent hypertension and enhance its detection, treatment and control not only in high-income countries but also in low- and middle-income nations. Although the nutritional, behavioural and environmental causes of raised blood pressure are well-established, little is known on what actions and interventions that can be widely replicated are responsible for the observed reductions in hypertension prevalence.23 Similarly, while randomised trials have demonstrated the efficacy of hypertension treatment, and studies in some countries or communities have shown that strategies such as simple evidence-based guidelines, the use of non-physician health workers and text messages can improve hypertension care,1,2,24-30 there is currently little transferable guidance on how to achieve high rates of detection, treatment and control for entire populations. Implementation research on the role of risk factors and health system determinants of hypertension care and management requires detailed country level data. Below, we discuss some lessons from countries which have substantially reduced prevalence or increased the coverage and effectiveness of treatment. Information for seven countries with high rates of treatment is summarised in Appendix Table 4.

Over the period of our analysis, lower hypertension prevalence was achieved while obesity, which is a risk factor for hypertension, increased,8 which implies that its dietary and environmental determinants must have improved. It may be possible to reduce salt intake and prevent hypertension through a combination of fiscal, regulatory and possibly behavioural interventions,31,32 although there are few examples of successful national programmes so far. Higher availability and consumption of fruits and vegetables33 may partly account for the observed declines in hypertension, which indicates that making them affordable (e.g., through targeted subsidies for poorer families) and accessible (e.g., through more efficient supply and storage) may be effective for hypertension prevention.

Expanding hypertension detection has been helped by both more widespread and regular contact with health services and more frequent measurement of blood pressure.34,35 Higher care utilisation requires universal health insurance36-39 and expansion of primary care. In some countries, training non-physician health workers in management of non-communicable diseases (NCDs) may be needed.24-28 Guidelines, availability of blood pressure monitors, and regular health checks and screening programmes40-44 facilitate more frequent measurement. The expansion of universal health coverage and primary care in places with low rates of diagnosis, especially sub-Saharan Africa and south Asia, provides an opportunity for improving hypertension care,45,46 but need to be accompanied with guidelines,47 training and blood pressure monitors in health facilities. Improvements in treatment have been helped by some of the same factors as diagnosis, guidelines that recommend progressively lower thresholds to initiate treatment and wider availability and lower cost of antihypertensive medicines, many of which are no longer under a patent.48 Despite this improvement, lack of access to medicines contributes to the low treatment rates in some low-income countries.46,49-51

We also found large variation in hypertension control among those who were treated. Understanding the reasons for the large variation in real-world effectiveness of treatment needs data on both the health system features that enable high quality care and the type of pharmacologic approach used, e.g., renin-angiotensin system inhibitors, calcium-channel blockers or diuretics;52 whether single-pill combination therapy is used;53 how much the prescribing physician titrates or intensifies treatment when needed; and patient adherence to treatment. New technologies such as telemonitoring, home blood pressure monitoring and text message reminders may improve adherence,29,54-56 but they can be effective only if there is uninterrupted access to effective medicines.

Hypertension prevention and control can make substantial contribution to achieving Sustainable Development Goals target 3.4 on NCDs.57,58 Countries such as Canada, Costa Rica, South Korea and Taiwan have achieved low hypertension prevalence and/or high control through both better prevention and improving every stage of the treatment cascade.30,59 Universal insurance has been instrumental in achieving high effective coverage, but should be complemented with primary care strengthening, up-to-date evidence-based hypertension guidelines that are adapted to the country contexts,47 health workforce training, and a robust system of drug procurement and distribution.30 Programmes should also be regularly evaluated, both at the population level, as our work has done, and in health facilities to ensure accountability and stimulate improvement.60

**Contributions**

BZ, GD, LMR, GAS, EWG and ME designed the study. Members of the Country and Regional Data Group collected and re-analysed data and checked pooled data for accuracy of information about their study and other studies in their country. BZ and RMCL led the data collection with help from BS, RKS, MKS, MLCI, VPFL, MJC and SS. BZ led the statistical analysis with input from GD, CJP, JEB and ME and prepared results. Members of the Pooled Analysis and Writing Group contributed to study design, collated data, and checked all data sources in consultation with the Country and Regional Data Group. Country and Regional Data Group members, BZ, RMCL, BS, RKS and VPFL had access to the data used in the study. BZ and ME wrote the first draft of the report with input from other members of the Pooled Analysis and Writing Group. Members of the Country and Regional Data Group commented on the draft report. ME oversaw research. The authors alone are responsible for the views expressed in this Article and they do not necessarily represent the views, decisions, or policies of the institutions with which they are affiliated.

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**Conflict of interest**

RC reports grants from Ministry of Health of the Czech Republic and personal fees from Herbacos Recordati, Amegen, Krka, outside the submitted work. GD reports consulting fees from Vital Strategies Inc. and honorarium from American College of Cardiology, outside the submitted work. ME reports a charitable grant from the AstraZeneca Young Health Programme and personal fees from Prudential, outside the submitted work. CJP reports holding stocks of Pfizer Inc., outside the submitted work. JS reports ownership in companies providing services to Itrim, Amgen, Janssen, Novo Nordisk, Eli Lily, Boehringer, Bayer, Pfizer and AstraZeneca, outside the submitted work. MW reports personal fees from Amgen, Kyowa Kirin and Freeline, outside the submitted work.

**Data sharing statement**

Computer code and age-standardised and crude results of this study can be downloaded from www.ncdrisc.org, and age-specific results can be requested, via the same website. The input data are available at www.ncdrisc.org when permitted by data governance and sharing arrangements; contact information is provided for other data sources.

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**Figure 1.** Number of data sources by country.

**Figure 2.** Prevalence of hypertension in 2019 and change from 1990 to 2019 in women and men.

The density plot alongside each map shows the distribution of estimates across countries. The top right panel shows the results ordered within regions and super-regions together with their 95% credible intervals. The bottom right panel shows change from 1990 to 2019 in hypertension prevalence in relation to the uncertainty of the change measured by posterior standard deviation; shaded areas show the posterior probability of an estimated increase or decrease being a true increase or decrease. Each point shows one country. See Appendix Table 3 for numerical results. SD: standard deviation. PP: posterior probability.

**Figure 3.** Hypertension treatment cascade in 2019, for women and men globally and by region. Each stream shows the leakage of people with hypertension throughout the treatment cascade and its associated percentage.

**Figure 4.** Proportion of women and men with hypertension who (A) used treatment and (B) whose blood pressure was controlled in 2019, and change from 1990 to 2019. See Appendix Figures 3 and 4 for the uncertainty of the estimated change. See Appendix Figure 2 for control rates among those on treatment and Appendix Figure 3 for a comparison of treatment and control rates.

The density plot alongside each map shows the distribution of estimates across countries. The top right panel shows the results ordered within regions and super-regions together with their 95% credible intervals. The bottom right panel shows change from 1990 to 2019 in hypertension treatment and control rates in relation to the uncertainty of the change measured by posterior standard deviation; shaded areas show the posterior probability of an estimated increase or decrease being a true increase or decrease. Each point shows one country. See Appendix Table 3 for numerical results. SD: standard deviation. PP: posterior probability.

**Figure 5.** Proportion of women and men with hypertension who had untreated stage 2 hypertension by country in 2019, and change from 1990 to 2019.

The density plot alongside each map shows the distribution of estimates across countries. The top right panel shows the results ordered within regions and super-regions together with their 95% credible intervals. The bottom right panel shows change from 1990 to 2019 in the proportion of untreated stage 2 hypertension in relation to the uncertainty of the change measured by posterior standard deviation; shaded areas show the posterior probability of an estimated increase or decrease being a true increase or decrease. Each point shows one country. See Appendix Table 3 for numerical results. SD: standard deviation. PP: posterior probability.

**Figure 6.** Trends in the number of people with hypertension who reported a diagnosis, who used treatment, and whose blood pressure was effectively controlled, globally and by region from 1990 to 2019. See Appendix Figure 6 for trends in the proportions of people with hypertension who reported a diagnosis, who had treatment, and whose blood pressure was effectively controlled, globally and by region.

**References**

1. Olsen MH, Angell SY, Asma S, et al. A call to action and a lifecourse strategy to address the global burden of raised blood pressure on current and future generations: the Lancet Commission on hypertension. *Lancet* 2016; **388**: 2665-712.

2. Zhou B, Perel P, Mensah GA, Ezzati M. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. *Nat Rev Cardiol* 2021; published online May 28.

3. World Health Organization. WHO model list of essential medicines (21st List). 2019. https://apps.who.int/iris/bitstream/handle/10665/325771/WHO-MVP-EMP-IAU-2019.06-eng.pdf (accessed 1 November 2020).

4. Ettehad D, Emdin CA, Kiran A, et al. Blood pressure lowering for prevention of cardiovascular disease and death: a systematic review and meta-analysis. *Lancet* 2016; **387**: 957-67.

5. Suchard MA, Schuemie MJ, Krumholz HM, et al. Comprehensive comparative effectiveness and safety of first-line antihypertensive drug classes: a systematic, multinational, large-scale analysis. *Lancet* 2019; **394**: 1816-26.

6. Gee ME, Campbell N, Sarrafzadegan N, et al. Standards for the uniform reporting of hypertension in adults using population survey data: recommendations from the World Hypertension League Expert Committee. *J Clin Hypertens (Greenwich)* 2014; **16**: 773-81.

7. Benetos A, Petrovic M, Strandberg T. Hypertension management in older and frail older patients. *Circ Res* 2019; **124**: 1045-60.

8. NCD Risk Factor Collaboration. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19.1 million participants. *Lancet* 2017; **389**: 37-55.

9. Finucane MM, Paciorek CJ, Danaei G, Ezzati M. Bayesian estimation of population-level trends in measures of health status. *Stat Sci* 2014; **29**: 18-25.

10. Danaei G, Finucane MM, Lin JK, et al. National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5.4 million participants. *Lancet* 2011; **377**: 568-77.

11. Zhang Y, Moran AE. Trends in the prevalence, awareness, treatment, and control of hypertension among young adults in the United States, 1999 to 2014. *Hypertension* 2017; **70**: 736-42.

12. NCD Risk Factor Collaboration. Long-term and recent trends in hypertension awareness, treatment, and control in 12 high-income countries: an analysis of 123 nationally representative surveys. *Lancet* 2019; **394**: 639-51.

13. Ahmad OB, Boschi-Pinto C, Lopez AD, Murray CJ, Lozano R, Inoue M. Age standardization of rates: a new WHO standard. GPE Discussion Paper Series: No.31. Geneva: World Health Organization, 2001.

14. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects 2019, Online Edition. Rev. 1., 2019.

15. Mills KT, Bundy JD, Kelly TN, et al. Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation* 2016; **134**: 441-50.

16. Geldsetzer P, Manne-Goehler J, Marcus ME, et al. The state of hypertension care in 44 low-income and middle-income countries: a cross-sectional study of nationally representative individual-level data from 1.1 million adults. *Lancet* 2019; **394**: 652-62.

17. Okura Y, Urban LH, Mahoney DW, Jacobsen SJ, Rodeheffer RJ. Agreement between self-report questionnaires and medical record data was substantial for diabetes, hypertension, myocardial infarction and stroke but not for heart failure. *J Clin Epidemiol* 2004; **57**: 1096-103.

18. Wu CS, Lai MS, Gau SS, Wang SC, Tsai HJ. Concordance between patient self-reports and claims data on clinical diagnoses, medication use, and health system utilization in Taiwan. *PLoS One* 2014; **9**: e112257.

19. Robinson JR, Young TK, Roos LL, Gelskey DE. Estimating the burden of disease. Comparing administrative data and self-reports. *Med Care* 1997; **35**: 932-47.

20. Matsumoto M, Harada S, Iida M, et al. Validity assessment of self-reported medication use for hypertension, diabetes, and dyslipidemia in a pharmacoepidemiologic study by comparison with health insurance claims. *J Epidemiol*. Published online 22 Dec 2020.

21. Myers MG, Godwin M, Dawes M, et al. Conventional versus automated measurement of blood pressure in primary care patients with systolic hypertension: randomised parallel design controlled trial. *BMJ* 2011; **342**: d286.

22. Plumettaz C, Viswanathan B, Bovet P. Hypertension prevalence based on blood pressure measurements on two vs. one visits: a community-based screening programme and a narrative review. *Int J Environ Res Public Health* 2020; **17**: 9395.

23. NCD Risk Factor Collaboration. Contributions of mean and shape of blood pressure distribution to worldwide trends and variations in raised blood pressure: a pooled analysis of 1018 population-based measurement studies with 88.6 million participants. *Int J Epidemiol* 2018; **47**: 872-83i.

24. Joshi R, Thrift AG, Smith C, et al. Task-shifting for cardiovascular risk factor management: lessons from the Global Alliance for Chronic Diseases. *BMJ Glob Health* 2018; **3**: e001092.

25. Himmelfarb CR, Commodore-Mensah Y, Hill MN. Expanding the role of nurses to improve hypertension care and control globally. *Ann Glob Health* 2016; **82**: 243-53.

26. Lekoubou A, Awah P, Fezeu L, Sobngwi E, Kengne AP. Hypertension, diabetes mellitus and task shifting in their management in sub-Saharan Africa. *Int J Environ Res Public Health* 2010; **7**: 353-63.

27. Labhardt ND, Balo JR, Ndam M, Grimm JJ, Manga E. Task shifting to non-physician clinicians for integrated management of hypertension and diabetes in rural Cameroon: a programme assessment at two years. *BMC Health Serv Res* 2010; **10**: 339.

28. Farzadfar F, Murray CJ, Gakidou E, et al. Effectiveness of diabetes and hypertension management by rural primary health-care workers (Behvarz workers) in Iran: a nationally representative observational study. *Lancet* 2012; **379**: 47-54.

29. Andre N, Wibawanti R, Siswanto BB. Mobile phone-based intervention in hypertension management. *Int J Hypertens* 2019; **2019**: 9021017.

30. Campbell NR, Sheldon T. The Canadian effort to prevent and control hypertension: can other countries adopt Canadian strategies? *Curr Opin Cardiol* 2010; **25**: 366-72.

31. Hyseni L, Elliot-Green A, Lloyd-Williams F, et al. Systematic review of dietary salt reduction policies: evidence for an effectiveness hierarchy? *PLoS One* 2017; **12**: e0177535.

32. McLaren L, Sumar N, Barberio AM, et al. Population-level interventions in government jurisdictions for dietary sodium reduction. *Cochrane Database Syst Rev* 2016; **9**: CD010166.

33. Bentham J, Singh GM, Danaei G, et al. Multi-dimensional characterisation of global food supply from 1961-2013. *Nat Food* 2020; **1**: 70-5.

34. Varghese C, Nongkynrih B, Onakpoya I, McCall M, Barkley S, Collins TE. Better health and wellbeing for billion more people: integrating non-communicable diseases in primary care. *BMJ* 2019; **364**: l327.

35. World Health Organization. Hypertension care in Thailand: best practices and challenges. 2019. https://apps.who.int/iris/rest/bitstreams/1265400/retrieve (accessed 1 December 2020).

36. Kwon S. Thirty years of national health insurance in South Korea: lessons for achieving universal health care coverage. *Health Policy Plan* 2009; **24**: 63-71.

37. Montenegro Torres F. Costa Rica case study: primary health care achievements and challenges within the framework of the Social Health Insurance. Washington DC: The World Bank, 2013. (Available online at: https://openknowledge.worldbank.org/bitstream/handle/10986/13279/74962.pdf).

38. Knaul FM, Gonzalez-Pier E, Gomez-Dantes O, et al. The quest for universal health coverage: achieving social protection for all in Mexico. *Lancet* 2012; **380**: 1259-79.

39. Su TC, Bai CH, Chang HY, et al. Evidence for improved control of hypertension in Taiwan: 1993-2002. *J Hypertens* 2008; **26**: 600-6.

40. Federal Ministry of Health of Germany. [Which screening tests are recommended]. 2021. https://www.bundesgesundheitsministerium.de/themen/krankenversicherung/online-ratgeber-krankenversicherung/medizinische-versorgung-und-leistungen-der-krankenversicherung/frueherkennung.html (accessed March 25 2021).

41. Shinbolatova A, Kulzhanov M, Aringazina A, Nurbakhyt A. Screening of arterial hypertension in the Republic of Kazakhstan: advantages, disadvantages and ways of improving. *Iran J Public Health* 2014; **43**: 1695-701.

42. Kim HS, Shin DW, Lee WC, Kim YT, Cho B. National screening program for transitional ages in Korea: a new screening for strengthening primary prevention and follow-up care. *J Korean Med Sci* 2012; **27 Suppl**: S70-5.

43. Nerenberg KA, Zarnke KB, Leung AA, et al. Hypertension Canada's 2018 guidelines for diagnosis, risk assessment, prevention, and treatment of hypertension in adults and children. *Can J Cardiol* 2018; **34**: 506-25.

44. US Preventive Services Task Force. Screening for hypertension in adults: US Preventive Services Task Force Reaffirmation Recommendation Statement. *JAMA* 2021; **325**: 1650-6.

45. National Health Mission, Ministry of Health & Family Welfare, Government of India. Prevention, screening and control of common non-communicable disesaes: hypertension, diabetes and common cancers (oral, breast, cervix), 2017. (Available online at: http://cancerindia.org.in/wp-content/uploads/2017/11/guidelines\_for\_population\_level\_screening\_of\_common\_NCDs.pdf).

46. Sorato MM, Davari M, Kebriaeezadeh A, Sarrafzadegan N, Shibru T, Fatemi B. Reasons for poor blood pressure control in eastern sub-Saharan Africa: looking into 4P's (primary care, professional, patient, and public health policy) for improving blood pressure control: a scoping review. *BMC Cardiovasc Disord* 2021; **21**: 123.

47. Owolabi M, Olowoyo P, Miranda JJ, et al. Gaps in hypertension guidelines in low- and middle-income versus high-income countries: a systematic review. *Hypertension* 2016; **68**: 1328-37.

48. Moser M. Historical perspectives on the management of hypertension. *J Clin Hypertens (Greenwich)* 2006; **8**: 15-20; quiz 39.

49. Attaei MW, Khatib R, McKee M, et al. Availability and affordability of blood pressure-lowering medicines and the effect on blood pressure control in high-income, middle-income, and low-income countries: an analysis of the PURE study data. *Lancet Public Health* 2017; **2**: e411-e9.

50. Husain MJ, Datta BK, Kostova D, et al. Access to cardiovascular disease and hypertension medicines in developing countries: an analysis of essential medicine lists, price, availability, and affordability. *J Am Heart Assoc* 2020; **9**: e015302.

51. van Mourik MS, Cameron A, Ewen M, Laing RO. Availability, price and affordability of cardiovascular medicines: a comparison across 36 countries using WHO/HAI data. *BMC Cardiovasc Disord* 2010; **10**: 25.

52. ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group. Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic: the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). *JAMA* 2002; **288**: 2981-97.

53. Gradman AH, Basile JN, Carter BL, Bakris GL, American Society of Hypertension Writing Group. Combination therapy in hypertension. *J Am Soc Hypertens* 2010; **4**: 42-50.

54. Burnier M, Egan BM. Adherence in hypertension. *Circ Res* 2019; **124**: 1124-40.

55. Parati G, Lombardi C, Pengo M, Bilo G, Ochoa JE. Current challenges for hypertension management: from better hypertension diagnosis to improved patients' adherence and blood pressure control. *Int J Cardiol* 2021; **331**: 262-9.

56. McManus RJ, Mant J, Franssen M, et al. Efficacy of self-monitored blood pressure, with or without telemonitoring, for titration of antihypertensive medication (TASMINH4): an unmasked randomised controlled trial. *Lancet* 2018; **391**: 949-59.

57. NCD Countdown collaborators. NCD Countdown 2030: pathways to achieving Sustainable Development Goal target 3.4. *Lancet* 2020; **396**: 918-34.

58. Kontis V, Mathers CD, Rehm J, et al. Contribution of six risk factors to achieving the 25x25 non-communicable disease mortality reduction target: a modelling study. *Lancet* 2014; **384**: 427-37.

59. Kim HC, Cho SMJ, Lee H, et al. Korea hypertension fact sheet 2020: analysis of nationwide population-based data. *Clin Hypertens* 2021; **27**: 8.

60. Campbell NRC, Ordunez P, DiPette DJ, et al. Monitoring and evaluation framework for hypertension programs. A collaboration between the Pan American Health Organization and World Hypertension League. *J Clin Hypertens (Greenwich)* 2018; **20**: 984-90.