Variation in the proportion of adults in need of BP-lowering medications by hypertension care guideline in low- and middle-income countries

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Variation in the Proportion of Adults in Need of Blood Pressure–Lowering Medications by Hypertension Care Guideline in Low- and Middle-Income Countries

A Cross-Sectional Study of 1 037 215 Individuals From 50 Nationally Representative Surveys

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BACKGROUND: Current hypertension guidelines vary substantially in their definition of who should be offered blood pressure–lowering medications. Understanding the effect of guideline choice on the proportion of adults who require treatment is crucial for planning and scaling up hypertension care in low- and middle-income countries.

METHODS: We extracted cross-sectional data on age, sex, blood pressure, hypertension treatment and diagnosis status, smoking, and body mass index for adults 30 to 70 years of age from nationally representative surveys in 50 low- and middle-income countries (N = 1 037 215). We aimed to determine the effect of hypertension guideline choice on the proportion of adults in need of blood pressure–lowering medications. We considered 4 hypertension guidelines: the 2017 American College of Cardiology/American Heart Association guideline, the commonly used 140/90 mm Hg threshold, the 2016 World Health Organization HEARTS guideline, and the 2019 UK National Institute for Health and Care Excellence guideline.

RESULTS: The proportion of adults in need of blood pressure–lowering medications was highest under the American College of Cardiology/American Heart Association, followed by the 140/90 mm Hg, National Institute for Health and Care Excellence, and World Health Organization guidelines (American College of Cardiology/American Heart Association: women, 27.7% [95% CI, 27.2–28.2], men, 35.0% [95% CI, 34.4–35.7]; 140/90 mm Hg: women, 26.1% [95% CI, 25.5–26.6], men, 31.2% [95% CI, 30.6–31.9]; National Institute for Health and Care Excellence: women, 11.8% [95% CI, 11.4–12.1], men, 15.7% [95% CI, 15.3–16.2]; World Health Organization: women, 9.2% [95% CI, 8.9–9.5], men, 11.0% [95% CI, 10.6–11.4]). Individuals who were unaware that they have hypertension were the primary contributor to differences in the proportion needing treatment under different guideline criteria. Differences in the proportion needing blood pressure–lowering medications were largest in the oldest (65–69 years) age group (American College of Cardiology/American Heart Association: women, 60.2% [95% CI, 58.8–61.6], men, 70.1% [95% CI, 68.8–71.3]; World Health Organization: women, 20.1% [95% CI, 18.8–21.3], men, 24.1.0% [95% CI, 22.3–25.9]). For both women and men and across all guidelines, countries in the European and Eastern Mediterranean regions had the highest proportion of adults in need of blood pressure–lowering medicines, whereas the South and Central Americas had the lowest.

CONCLUSIONS: There was substantial variation in the proportion of adults in need of blood pressure–lowering medications depending on which hypertension guideline was used. Given the great implications of this choice for health system capacity, policy makers will need to carefully consider which guideline they should adopt when scaling up hypertension care in their country.

The full author list is available on page 1000.

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Clinical Perspective

What Is New?

- The choice of a hypertension treatment guideline has a substantial influence on the number of adults who require blood pressure–lowing medications across low- and middle-income countries.
- The primary contributors to differences in treatment needs across guidelines are the number of older individuals and individuals who are unaware that they have hypertension and are in need of treatment.

What Are the Clinical Implications?

- Because the clinical care burden of hypertension is strongly influenced by which guideline is used, countries need to carefully decide which treatment guidelines can be realistically scaled up without overburdening clinical care or creating shortages in the supply of blood pressure–lowering medications.
- In addition to clinical care burdens, physicians and health policy experts will need to decide whether guidelines that place substantial numbers of older individuals on treatment can be justified in terms of their expected benefits relative to side effects within their specific country contexts.

Preventing and controlling hypertension is a major global public health strategy for reducing premature mortality from cardiovascular and cerebrovascular diseases (CVDs).[1] Hypertension control is especially important in low- and middle-income countries (LMICs) where CVD has already become the leading cause of both mortality and disability-adjusted life-years lost,[2,3] the prevalence of hypertension is high,[4] and both the mortality burden from CVD and hypertension prevalence are expected to increase dramatically over the coming decades as a result of population aging.[5,6] Despite its importance, rates of hypertension control in LMICs are generally low. In a recent study,[4] on average, only 10% of individuals with hypertension across 44 LMICs had controlled blood pressure (BP). Improving BP control in LMICs thus has tremendous potential to improve population health outcomes. It is feasible to realize this potential because measuring BP does not require extensive training or costly equipment, and BP-lowering medications are both highly effective and low cost.[7,8]

LMICs have adopted ambitious goals to scale up hypertension care.[9,10] A necessary step for scaling up BP-lowering medications in LMICs is to clearly define which individuals need treatment. Available and widely used hypertension treatment guidelines differ considerably in how they define the population who would benefit and should be initiated on treatment.[1,11–13] Deciding who should receive BP-lowering medications is important for balancing the benefits of treatment with potential side effects and, because of the differences in the proportion of the population who would need treatment across guidelines, for helping policy makers in LMICs decide which guidelines can be realistically operationalized.

In this study, we estimate how the proportion of adults 30 to 70 years of age in need of BP-lowering medications varies across 4 major hypertension guidelines in 50 LMICs that collectively account for 55% of the global population and 66% of the global LMIC population. To inform the targeting of scale-up efforts for hypertension care, we categorize the proportion of individuals who are in need of BP-lowering medicines into 3 groups on the basis of the hypertension care cascade stage: (1) the proportion who are unaware that they have hypertension, (2) the proportion who are diagnosed but not initiated on treatment, and (3) the proportion who are diagnosed and receive BP-lowering medications but still have uncontrolled BP.

METHODS

The data, analytical methods, and study materials will be made available in the Harvard Dataverse.

Data Sources

We conducted a systematic search to identify household survey data sets with the following characteristics: (1) was conducted in a country that was an LMIC at the time of data collection (according to the World Bank income classification[14]), (2) was carried out during or after 2005, (3) was conducted in at least two 10-year age groups >15 years of age, (4) was nationally representative, (5) had a response rate ≥50%, and (6) took at least 2 BP measurements during the survey interview. We judged a survey to be nationally representative if the official survey documentation explicitly stated that the survey was nationally representative and was based on a probability sample designed to produce nation-level estimates. Using these criteria, we identified and included 50 data sets. The only 2 exceptions we included were the Indonesian Family Life Survey, which is representative of 83% of the Indonesian population (more remote islands and areas under conflict at the time of the baseline survey were excluded from the sampling frame),[15] and the China Health and Nutrition Survey, which has broad coverage from several geographic regions in China but is not explicitly nationally representative.[16] We provide an overview of each of the data sets in the Table; more detailed information on the data identification process has been published previously.[4]

We also extracted data on population counts for each country by sex and 5-year age group between 30 and 70 years of age from the 2019 United Nations World Population Prospects.[17] For each country, we chose the United Nations World Population Prospects year that was closest to the country survey year.

Inclusion Criteria

Our population of interest is adults 30 to 70 years of age. We use 30 years as our lower age threshold because hypertension

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Table. Descriptive Characteristics of the Countries and Samples Used in the Analysis

Country	World Bank income group	Population 30-70 y of age, 1000s*	Survey	Survey year	Response rate, %	Proportion missing	Sample size, n†	Proportion female‡	Median age, y‡
Africa									
Algeria	UM	16 425	STEPS	2016	93	0.054	5185	0.55	45
Benin	L	2918	STEPS	2015	99	0.042	3344	0.51	42
Botswana	UM	746	STEPS	2014	64	0.039	2408	0.69	43
Burkina Faso	L	4634	STEPS	2013	98	0.173	2838	0.51	41
Comoros	L	196	STEPS	2011	97	0.075	4020	0.69	42
Eswatini	LM	313	STEPS	2014	82	0.136	1807	0.67	45
Ghana	L	7618	SAGE	2008–2009	79	0.127	3394	0.44	55
Kenya	LM	13 689	STEPS	2015	95	0.043	2896	0.58	42
Lesotho	LM	593	STEPS	2012	80	0.066	1773	0.66	46
Liberia	L	1100	STEPS	2011	87	0.069	1225	0.53	39
Mozambique	L	5352	STEPS	2005	98	0.1	2303	0.56	42
Namibia	UM	711	Demographic and Health Surveys	2013	97	0.226	3410	0.58	46
Seychelles	UM	47	National Survey of Noncommuni-cable Diseases	2013	73	0.002	1123	0.57	49
South Africa	UM	22 086	National Income Dynamics Study	2017	69	0.186	10 935	0.61	44
Tanzania	L	11 578	STEPS	2012	95	0.038	4483	0.52	43
Togo	L	1797	STEPS	2010	91	0.069	2395	0.49	41
Uganda	L	8790	STEPS	2014	99	0.056	2237	0.59	41
Zambia	LM	3900	STEPS	2017	78	0.063	2513	0.61	43
South and Central Americas									
Belize	UM	86	CAMDI	2005–2006	93	0.149	1336	0.57	45
Brazil	UM	96 623	Pesquisa Nacional de Saude	2013	86	0.077	38 847	0.57	45
Chile	UM	8014	National Health Survey	2009–2010	85	0.085	3127	0.6	48
Costa Rica	UM	2002	STEPS	2010	88	0.154	2218	0.74	47
Ecuador	UM	5682	Encuesta Nacional de Salud y Nu-trición	2012	82	0.003§	9926	0.32	40
Grenada	UM	44	STEPS	2010–2011	65	0.042	902	0.6	47
Guyana	UM	308	STEPS	2016	67	0.018	1926	0.59	46
Mexico	UM	45 285	Mexican Family Life Survey	2009–2012	90	0.245	9159	0.59	46
St. Vincent and the Grenadines	UM	50	STEPS	2013	68	0.018	2661	0.54	47
Eastern Mediterranean									
Iran	UM	35 799	STEPS	2016	99	0.04	20 798	0.52	45
Iraq	UM	10 735	STEPS	2015	94	0.165	2350	0.62	45
Lebanon	UM	2747	STEPS	2017	70	0.091	1491	0.58	50
Morocco	LM	14 661	STEPS	2017	89	0.024	3835	0.65	47
Sudan	LM	11 272	STEPS	2015	88	0.051	5039	0.61	44

(*Continued*)

Table. Continued

Country	World Bank income group	Population 30-70 y of age, 1000s*	Survey	Survey year	Response rate, %	Proportion missing	Sample size, n†	Proportion female‡	Median age, y‡
Europe									
Azerbaijan	UM	4491	STEPS	2017	97	0.042	2224	0.59	50
Belarus	UM	5152	STEPS	2016	87	0.006	4296	0.59	51
Georgia	LM	2040	STEPS	2016	76	0.057	3391	0.71	53
Kazakhstan	UM	7043	Kazakhstan Household Health Survey	2012	93	0.158	6780	0.57	47
Kyrgyzstan	LM	2246	STEPS	2013	97	0.024	2179	0.63	47
Moldova	LM	2150	STEPS	2013	84	0.07	3682	0.62	52
Tajikistan	LM	2776	STEPS	2016	94	0.017	1937	0.6	45
Southeast Asia									
Bhutan	LM	273	STEPS	2014	97	0.019	2114	0.59	44
India	LM	537 312	Annual Health Survey/District Level Household Survey	2013–2014	89‖	0.281	790 848	0.53	45
Indonesia	LM	114 835	Indonesian Family Life Survey	2014	83	0.027	19 743	0.52	42
Myanmar	LM	22 540	STEPS	2014	90	0.045	7141	0.65	47
Nepal	L	9227	STEPS	2013	98	0.01	3139	0.67	45
Sri Lanka	LM	10 021	STEPS	2014	72	0.083	4021	0.6	47
Timor-Leste	LM	344	STEPS	2014	96	0.047	1845	0.55	45
Western Pacific									
Cambodia	L	4514	STEPS	2010	96	0.035	4445	0.65	46
China	UM	757 572	China Health and Nutrition Survey	2015	88	0.114	8836	0.54	52
Mongolia	LM	1071	STEPS	2009	95	0.015	3777	0.41	42
Vanuatu	LM	75	STEPS	2011	94	0.044	3641	0.49	43
Across-survey median		4502			90	0.055	3242	0.59	45

Classifications of income are for the survey year. L indicates low; LM, lower middle; STEPS, The WHO STEPwise Approach to Surveillance; and UM, upper middle.
*Population size is from the United Nations World Population Prospects, 2019 revision, data for the nearest year to the survey year.
†Sample size after the exclusion of individuals with missing data.
‡These estimates are unweighted.
§This is an approximate estimate of the share missing because we were not able to exactly determine which individuals in the survey were eligible for the blood pressure measurements.
‖The Indian data were collected as 2 separate surveys; this response rate is for the District Level Household Survey 4, which covered the majority of the Indian states. The second survey, the Annual Health Survey, did not publish a response rate.

guidelines generally recommend screening from about this age on.[11] We restrict our upper threshold to 70 years because that is the maximum age for which we have measurements of BP for the majority of countries in our data. This was a complete case analysis. We excluded individuals who were missing any information on age, sex, systolic BP, diastolic BP, hypertension diagnosis and treatment information, body mass index, and current smoking status.

Hypertension Treatment Guidelines

We consider 4 separate hypertension guidelines to determine which individuals are in need of BP-lowering medications: the commonly used 140/90 mm Hg (140/90) threshold,[13,18–21] the 2016 World Health Organization HEARTS/Package of Essential Noncommunicable Disease Interventions (WHO HEARTS) guidelines,[1] the 2017 American College of Cardiology/American Heart Association (ACC/AHA) guideline,[12] and the UK National Institute for Health and Care Excellence (NICE) 2019 guideline.[11] We included the 140/90 threshold because it is widely used across LMICs, including in major countries such as China, India, Brazil, and South Africa,[18–22] across Europe for individuals <80 years of age in the form of the 2018 European Society of Cardiology/European Society of Hypertension guidelines,[13] and recently as the 2020 International Society of Hypertension guidelines (for patients deemed low risk of a cardiovascular disease end point in settings with limited availability of medicines, the threshold to determine treatment is moved to 160/100 mm Hg)[23]; the WHO HEARTS guideline because it is officially recommended by the WHO for all LMICs; and the ACC/AHA and NICE guidelines because they are the 2 other main guidelines currently used in high-income countries. Although the ACC/AHA guideline was developed for the United States, several prominent articles have raised the question of whether it should also be used in LMICs[24–28]; we thus included this guideline to provide further evidence to inform this decision across LMICs. We show the thresholds for each guideline in Table I in the Data Supplement.

CVD Risk

Three of the guidelines (ACC/AHA, NICE, and WHO HEARTS) base their guidance on both BP and predicted 10-year risk of a CVD event (from here forward, CVD risk). Each guideline recommends using a distinct CVD risk calculator; however, although there are many CVD risk scores,[29–33] most have not been calibrated for LMIC populations. For this reason, we use the WHO/International Society of Hypertension risk score for all 3 guidelines because it is widely used across LMICs and is calibrated for different world regions.[32] Using a common CVD risk calculator also allowed us to assess the influence of different thresholds and guidelines net of the influence of differences in CVD risk prediction. Specifically, we use the non-laboratory score that uses information on body mass index in place of total cholesterol and diabetes status because blood glucose and cholesterol measurements were not collected for the majority of our surveys. As a sensitivity analysis, we present the main results using the Globorisk CVD scores instead of the WHO/International Society of Hypertension score because Globorisk is the only other score, to the best of our knowledge, that has been calibrated for all LMICs (Figures I through III in the Data Supplement).[29]

Measurement of BP

The surveys in 40 countries measured BP with a digital upper arm meter, 1 survey with a digital wrist meter, and 2 surveys with a manual mercury sphygmomanometer (Table II in the Data Supplement). We were unable to find documentation on the BP measurement device that was used in 7 surveys (Algeria, Azerbaijan, Botswana, Kyrgyzstan, Sri Lanka, Sudan, and Tajikistan). Forty-three countries measured BP at least 3 times; 3 countries measured 2 times with a third measurement if the first 2 differed by a predefined margin; and 4 countries measured 2 times. For participants with ≥3 BP measurements, we used the mean of the last 2 measurements; for participants with only 2 BP measurements, we averaged both available measurements. In case the second or third BP measurement was missed in a participant, we used the single measurement provided.

Statistical Analyses

Our analysis had 4 main steps. First, we determined which individuals in the data are in need of BP-lowering medications under each of the 4 guidelines on the basis of their measured systolic and diastolic BPs, CVD risk, and the thresholds specified in Table I in the Data Supplement. Among those individuals, we further classified them into 3 mutually exclusive categories (separately for each guideline): those who are unaware that they have hypertension, those who have been diagnosed but are not currently on treatment, and those who have been diagnosed and are on treatment but are in need of further care (ie, to improve adherence) or treatment (ie, additional or a higher dose of medicines) to achieve BP control.

Second, we used a multinomial logistic regression model to estimate the proportion of individuals in each of these 3 treatment categories for each 5-year age group between 30 and 70 years (separately for each guideline and by sex and country). We used a regression model to smoothly estimate these proportions rather than estimating them directly to reduce sampling error. Fourteen of the 50 countries did not contain information on individuals between 65 and 69 years of age, and 2 (Ecuador and Namibia) additionally did not contain information for individuals 60 to 64 years of age. For these countries, we used the estimated regression models to extrapolate the age pattern of treatment needs into the missing age groups. These models were weighted by the survey-specific sample weights. We present the fit of the models for each country in Figures IV through LIII in the Data Supplement.

Third, to determine the number of individuals in need of BP-lowering medications by levels of the treatment cascade within each age group, we multiplied the estimated age-specific proportions of individuals in each treatment category by the age-specific population counts for each country.

Fourth, we estimated the overall proportion of adults between 30 and 70 years of age in need of BP-lowering medications by simply dividing the total number of individuals in each treatment category across ages by the total population between 30 and 70 years of age. We present our results across LMICs globally and separately by country, age, sex, and WHO world regions. Using the United Nations World Population Prospects data ensured that aggregated estimates (across ages, countries, and regions) were weighted proportionately to each contributing country's population size.

Institutional Review Board Approval

Our study was exempt from Institutional Review Board review because it uses publicly available and deidentified secondary data.

RESULTS

Descriptive Characteristics of the Sample

Our analytical sample consisted of 1 037 215 individuals with an across-survey median response rate of 90%. Among the 50 countries included in our data, 11 were classified as low-income countries, 18 as lower-middle-income countries, and 21 as upper-middle-income countries (Table). The countries represented population sizes ranging from 44 000 in Grenada to 757 572 000 in China with an across-country median 30- to 70-year-old population of 4.5 million individuals. The proportion of individuals excluded because of missingness varied from 28% in India to <1% in Belarus with an across-country median of 5.5%.

Proportion of Individuals in Need of BP-Lowering Medications by Guideline

There was substantial variation in the proportion of adults in need of BP-lowering medications across the 4 guidelines (Figure 1; 95% CIs are shown in Table III in the Data Supplement). The ACC/AHA guideline placed the greatest proportion of adults in need of BP-lowering medications (women: 27.7% [95% CI, 27.2–28.2]; men: 35.0% [95% CI, 34.4–35.7]), followed by the 140/90 threshold (women: 26.1% [95% CI, 25.5–26.6]; men: 31.2% [95% CI, 30.6–31.9]), the NICE guideline (women: 11.8% [95% CI, 11.4–12.1]; men: 15.7% [95% CI, 15.3–16.2]), and last the WHO HEARTS guideline (women: 9.2% [95% CI, 8.9–9.5]; men: 11.0% [95% CI, 10.6–11.4]).

Individuals who were unaware that they have hypertension were the primary contributor to differences in the total proportion in need of BP-lowering medications across guidelines. For example, this proportion was 20.1% (95% CI, 19.7–20.6) for women and 28.4% (95% CI, 27.7–29.1) for men under the ACC/AHA guideline compared with just 5.6% (95% CI, 5.4–5.9) and 8.0% (95% CI, 7.6–8.3) under the WHO HEARTS guideline for women and men, respectively. In contrast, there were only small differences in the proportion of individuals who were diagnosed and in need of BP-lowering medications across guidelines.

Differences in the Proportion of Individuals in Need of BP-Lowering Medications by Age

The proportion of individuals in need of BP-lowering medications increased substantially with age across all 4 guidelines (Figure 2). Beyond this overall age trend, there were 3 distinct points of divergence and convergence. Between 30 and 50 years of age for women and 30 and 45 years of age for men, the primary differences were between the ACA/AHA and 140/90 guidelines on one hand and the NICE and WHO HEARTS guidelines on the other hand. After 45 to 50 years of age, the 4 guidelines diverged, with the ACC/AHA having the highest proportions, followed by the 140/90, NICE, and WHO HEARTS. By 70 years of age, the ACC/AHA guideline had much higher proportions, whereas differences between the 140/90 threshold and NICE guidelines nearly disappeared, and the WHO guideline continued to have the lowest proportions.

Differences in the Proportion of Individuals in Need of BP-Lowering Medications by Country

Across all 4 guidelines, Belarus, Moldova, Kyrgyzstan, and Tajikistan had the highest proportions in need of BP-lowering medications, whereas Belize, Costa Rica,

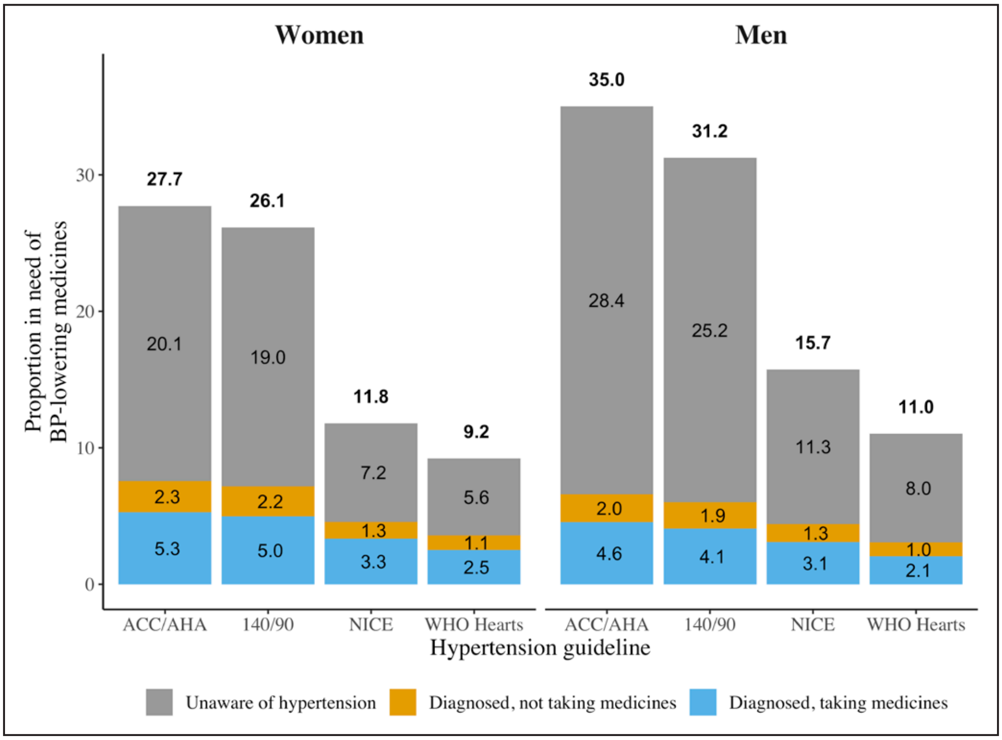

Figure 1. BP treatment needs by guidelines across 50 LMICs.
Proportion (percent) of adults 30 to 70 years of age from 50 LIMCs in need of BP-lowering medicines by hypertension treatment guidelines, stages of hypertension care, and sex. Countries are weighted by proportionate size of their population from 30 to 70 years of age. We show the 95% CIs for each estimate in Table III in the Data Supplement. ACC/AHA indicates American College of Cardiology/American Heart Association; BP, blood pressure; LMICs, low- and middle-income countries; NICE, National Institute for Health and Care Excellence; and WHO, World Health Organization.

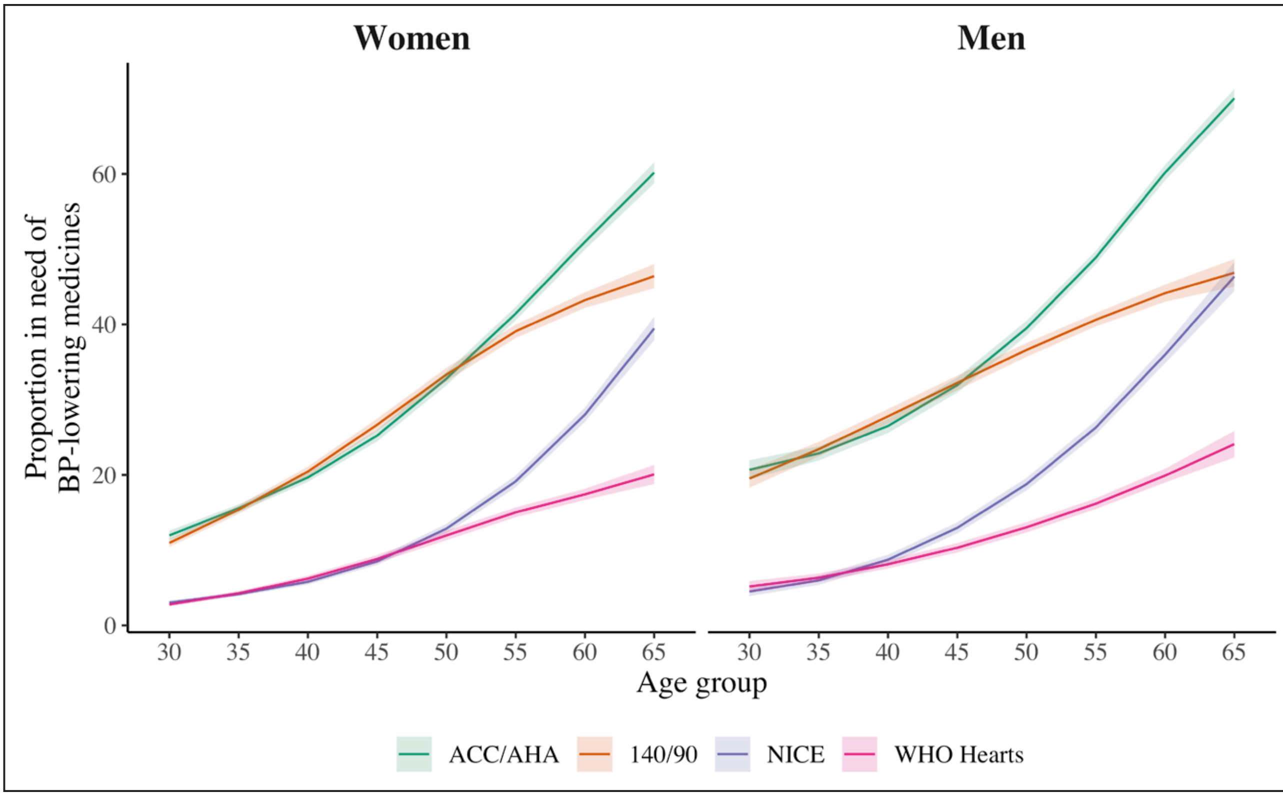

Figure 2. BP treatment needs by guidelines and age.
Proportion of the population in need of BP-lowering medicines by guideline across age groups and sex. Shaded areas are 95% CIs. ACC/AHA indicates American College of Cardiology/American Heart Association; BP, blood pressure; NICE, National Institute for Health and Care Excellence; and WHO, World Health Organization.

and Cambodia had the lowest (Figure 3; 95% CIs are shown in Table IV in the Data Supplement). For example, under the ACC/AHA guidelines, the proportion in need of treatment was 57.9% (95% CI, 56.4–59.3) in Belarus and 14.4% (95% CI, 13.2–15.6) in Cambodia. These differences, however, became smaller under the more conservative guidelines: Under the WHO HEARTS guideline, the proportion in need of treatment became 25.6% (95% CI, 24.2–26.9) and 3.9% (95% CI, 3.1–3.8) in Belarus and Cambodia, respectively.

Similar to the overall results, the largest contributor to the variance in treatment needs across countries and guidelines was country differences in the proportion of individuals unaware that they have hypertension. However, the proportions of individuals who were diagnosed but not taking treatment and who were diagnosed and taking treatment but still had uncontrolled BP were increasingly important among countries with larger overall treatment gaps.

Regional Results

In Table V and Figures LIV and LV in the Data Supplement, we present differences in the proportion of individuals in need of BP-lowering medications across guidelines by WHO regions and decompose the difference across regions. Broadly, the European region had the highest proportion of adults in need of BP-lowering medicines, and the lowest proportion was in the South and Central Americas. The ordering of needs across guidelines was identical for all regions and followed the pattern seen for the overall results. Higher age-specific CVD risks in Europe explained nearly all the difference in treatment needs compared with the South and Central Americas, Asia, and the Western Pacific, whereas the older age distribution of Europe was more important for differences compared with Africa and the Eastern Mediterranean regions.

DISCUSSION

We found that across 50 LMICs there were strikingly large differences in the proportion of adults in need of BP-lowering medicines, depending on which of the major hypertension treatment guidelines was used to identify individuals for treatment. Within every country, for both sexes, and across ages, the 2017 ACC/AHA guideline placed the largest proportion of adults in need of BP-lowering medicines, followed closely by the widely used 140/90.[18–21] In contrast, the NICE and WHO HEARTS guidelines classified fewer than half as many adults as being in need of BP-lowering medicines. These differences were most pronounced among

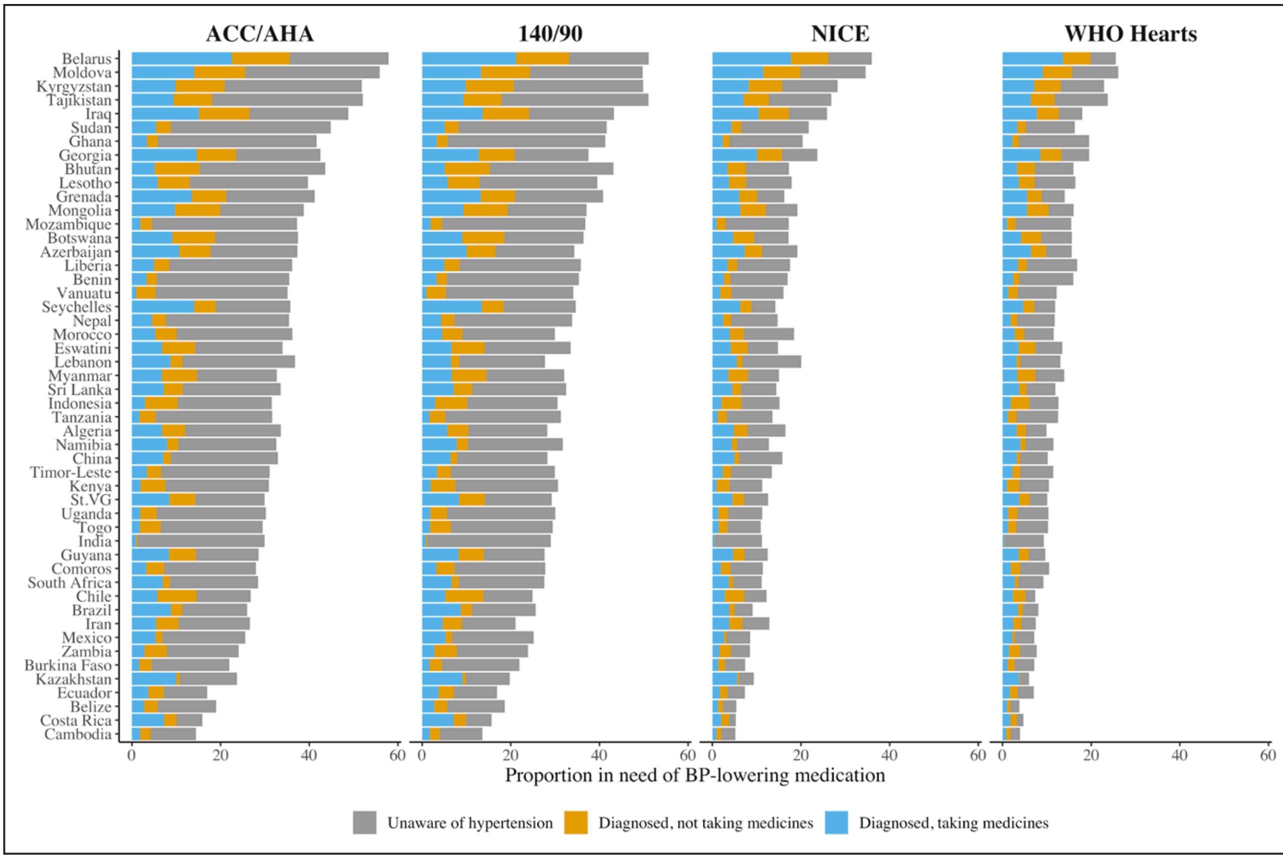

Figure 3. BP treatment needs by guidelines and country.
Proportion of adults ages 30 to 70 years from 50 low- and middle-income countries in need of BP-lowering medicines by hypertension treatment guideline and stages of the hypertension care. We show the numeric estimates with 95% CIs in Table V in the Data Supplement. ACC/AHA indicates American College of Cardiology/American Heart Association; BP, blood pressure; NICE, National Institute for Health and Care Excellence; and WHO, World Health Organization.

older individuals and were driven primarily by differences across guidelines in the proportion of individuals in need of BP-lowering medicines who were not diagnosed as having hypertension. This suggests that the choice of guideline to scale up BP medicine coverage will affect primarily how many new, and likely older, individuals will need to be brought into the care continuum and consequently the health system capacity that is needed to provide care to these new patients with hypertension.

In addition to the health system care burden, policy makers will need to weigh the expected health benefits and long-term cost savings (eg, from reducing the incidence of CVD events) from placing a larger proportion of the population onto BP-lowering medicines against the potential side effects of providing treatment to larger shares of the population. Unfortunately, despite a large body of evidence on the effects of hypertension treatment,[34] there is no conclusive evidence on which risk groups (in terms of BP levels, CVD risk, and age) benefit the most from BP treatment.[13] This uncertainty is heightened for LMIC populations in which there have been few longitudinal studies to ascertain individuals' long-term benefits from BP treatment. Therefore, an important unanswered question is how guidelines based on high-income country clinical-trial populations should be translated to LMIC populations who may benefit differently from BP-lowering medicines and have different CVD risks. Randomized controlled clinical trials or cohort studies of BP treatment in LMIC settings will be essential for resolving these debates.

The local health economic context is an important but often overlooked component of the content of hypertension care guidelines. To the best of our knowledge, only the recent International Society of Hypertension 2020 guideline explicitly accounts for these factors in the guideline recommendations, making distinctions, for example, between BP treatment thresholds when medicines are and are not easily available.[23] More broadly, other guidelines need to be aware of the availability and costs of antihypertensive medicines. In contexts with a limited availability of antihypertensive medications, guidelines that place a larger share of the population on treatment may be unfeasible to realize and may even prevent individuals at higher BPs, for whom BP reductions are more pressing, from having sufficient medication supply to adequately control their BP. Such guidelines would also place a greater financial burden on populations not only because more individuals would require medicines but also because individuals on treatment may require more medications to achieve control. This is especially important in poorer communities where aggressive hypertension guidelines may result in a high financial burden for families with individuals in need of treatment.

Closing the large treatment gaps across countries requires focusing resources at the largest bottlenecks in the hypertension care continuum. This is especially important in the Eastern European and Central Asian countries, where treatment gaps are much larger than in the other countries we considered. Our results reveal that the largest share of those in need of treatment are individuals who are unaware that they have hypertension. A major barrier to improving awareness and consequently diagnosis is that individuals in LMICs do not commonly seek preventive care such as for hypertension screening.[35] Therefore, closing this gap will require significantly expanding either opportunistic screening of individuals at health facilities or home- and community-based hypertension screening and diagnosis campaigns.[36,37] The effectiveness of community-based and opportunistic screening, however, will depend on communities' access to health facilities. In countries and regions with a limited supply of high-quality health facilities, closing hypertension gaps will first require addressing these health-systems shortages.

The next largest gap after awareness is treatment among diagnosed individuals. Although reasons for this gap are less explored in LMICs, emerging evidence suggests that beliefs that individuals have toward treatment may be a significant barrier to long-term treatment adherence. For example, studies of hypertension and of other conditions requiring repeat treatment have found that individuals often do not understand that they have to continuously take medicines even after they feel better[38] or, in the case of hypertension, after their BP reduces to a controlled level.[39,40] Improving knowledge on how to correctly use BP medications will be essential for closing this second gap.

There are several limitations that are important to the interpretation of our results. First, in most clinical care settings, BP medicines are given on the basis of the average of BP measurements taken on at least 2 consecutive occasions rather than on measurements taken in 1 sitting such as we used here. Several studies have found that rates of hypertension are exaggerated when estimated from measurements from 1 point in time. This is an important limitation and implies that our approach likely overestimates the number of individuals with persistently raised BP. Our estimates of the proportion in need of BP-lowering medication may be additionally overstated for Comoros, India, Mexico, and South Africa because they are based on only 2 BP measurements rather than the average of the last 2 of 3 readings as was the case for the other 46 countries. Unfortunately, we are unaware of any nationally representative data sources from LMICs that collect BP in a manner similar to clinical care; collecting such data or examining differences across guidelines in clinical data sources with BP measured on multiple occasions will be essential for future work in this area. Second, an across-survey median of 5.5% of age-eligible individuals were missing data and thus dropped from the sample. Our results may incorrectly represent the proportion of individuals in need of BP-lowering medicines if those who were missing data were more likely to require treatment. Third, the procedure used to measure BP and the questions used to ascertain CVD risk factors varied somewhat between certain countries. Therefore, differences in our study between countries may be driven partially by these measurement differences. However, this limitation does not affect our analysis of differences between guidelines within countries, which was the main objective of our study. Fourth, the surveys used in this study were collected in different years. Therefore, our findings should be interpreted as relating to each country-year pair rather than providing estimates for a common year across countries. Fifth, we had to extrapolate the proportion of individuals in need of BP-lowering medicines for 1 age group (65–69 years) for 14 countries and 2 age groups (60–64 and 65–69 years) for 2 countries according to the relationship between age and BP treatment needs in the ages with data. Given the regularity of the age–BP treatment needs relationship in ages with data for countries that have data all the way to 70 years of age (Figures IV–LIII in the Data Supplement), we believe any bias from the extrapolation is unlikely to change our main conclusions. A similar limitation is that we used the nonlaboratory CVD risk equations rather than the equations based on measured lipids and glucose. However, given the high cost of these laboratory measurements, the nonlaboratory scores are more likely to be used for efforts to scale up BP treatment in LMICs. Last, we did not distinguish between natural BP and the BP of individuals on medication; however, the guidelines considered here do not call for differential treatment for those who are already on medicines but rather are based on measured levels of BP and CVD risk. However, our results are likely conservative because they miss the small proportion of individuals in these countries who are on BP medicines but have their BP under control and thus do not get identified as in need of BP-lowering medicines under the guidelines.

This study of nationally representative data for a set of countries that collectively represent two-thirds of the global LMIC population highlights that the decision of which hypertension guideline is adopted has immense implications for the proportion of the adult population who are in need of BP-lowering medicines. Ultimately, the results of this study call attention to an important unresolved discussion of which individuals should actually receive BP treatment in LMICs.

Developing guidelines that acknowledge and are built for the unique conditions in each country will be critical for health service planning as LMICs prepare to scale up hypertension care over the coming years.

ARTICLE INFORMATION

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Disclosures

None.

Supplemental Materials

Data Supplement Tables I–V
Data Supplement Figures I–LV

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