Hypertension prevalence as a function of different guidelines, India
Manisha Dubey, Sanjay Rastogi & Ashish Awasthi

Objective To determine the effect of different hypertension management guidelines and of basing diagnosis on a single reading of blood pressure on the hypertension prevalence in the Indian population.

Methods We performed a secondary analysis of data acquired as part of the Fourth national family health survey, 2015 to 2016, over all districts in India. We calculated the proportion of the population within three different age groups (18 to 34, 35 to 49 and 18 to 49 years of age) with raised blood pressure according to six different guidelines, and how prevalence changed if diagnoses were based on a single blood pressure measurement.

Findings We observed that the Government of India and the American College of Cardiology/American Heart Association guidelines consistently yielded the lowest and highest prevalence of raised blood pressure; in the combined age group, we calculated the proportion of the population categorized as having raised blood pressure as 7.5% (95% confidence interval (CI): 7.4 to 7.7) and 40.1% (95% CI: 39.7 to 40.7), respectively. When basing diagnosis on a single reading of blood pressure only, a total of 56 million individuals would be erroneously categorized as hypertensive following the Government of India guidelines. We also showed that prevalence of hypertension in India varies with guidelines adhered to; in the combined age group, the national hypertension prevalence was three times higher when following the American College of Cardiology/American Heart Association compared with the Government of India guidelines.

Conclusion To optimize current clinical practice, health-care providers need to follow universally agreed, evidence-based methods of diagnosing hypertension.

Introduction
With developments in technology and the expansion of treatment options and modalities, the field of clinical care guidelines is constantly evolving. Although clinical care guidelines are only recommendations, the decision to follow a specific set of guidelines by a health-care provider should be based on the local context of need, availability and affordability, especially in low- and middle-income countries. The availability of different guidelines, with inconsistencies in recommendations of when medical treatment should be initiated, can cause friction between health-care provider and patient.

Blood pressure measurement is one of the most common non-invasive clinical practice tools used to assess the cardiovascular status of an individual and predict the likelihood of future cardiovascular events. An individual’s blood pressure can change quickly and regularly, and is influenced by respiration, temperature, bladder distension, pain levels, emotion, diet, time since last exercise and whether alcohol has recently been consumed. A simple method of obtaining an accurate blood pressure measurement is to take repeated readings over multiple visits. Compared with diagnoses of hypertension based on a single measurement of blood pressure, studies have demonstrated as much as 12% reduction in the prevalence of hypertension if repeated readings over multiple visits are considered. By considering multiple readings, up to 35% of patients were reclassified within a lower category of blood pressure. However, even after obtaining a more accurate blood pressure measurement, clinical care guidelines differ with respect to the precise blood pressure at which a patient is diagnosed as hypertensive and begins treatment. This lack of uniformity between the various available guidelines diminishes the value of measuring blood pressure.

Over the past 25 years, the availability of health-care services have increased in India, and the country has adopted a universal health coverage programme. Although the availability of health-care services has risen, the quality of treatment received from different health-care providers is not consistent. The causes of this inconsistency in quality across India include variations in clinical practice, poor diagnostic facilities, a lack of expertise, unnecessary use of medicines (e.g. antibiotics, analgesics and steroids) and substandard treatment. India is currently experiencing an increase in the prevalence of noncommunicable diseases, such as hypertension and diabetes, and the accompanying premature mortality. Inconsistent guidelines introduce uncertainty in the accuracy of hypertension diagnoses and increase the likelihood of poor health outcomes. Poor health-care literacy, high self-medication rate, poor blood pressure control and inconsistent hypertension management guidelines intensify the problem in India.

Here we have analysed the impact of inconsistent practices on the calculated prevalence of hypertension. We have focused on the particular blood pressure measurements at which hypertension is diagnosed and whether a single reading or the recommended number of readings was taken, for six different hypertension guidelines.
Hypertension in India
Manisha Dubey et al.

Methods

Data source

We used data from the most recent large-scale health survey, the Fourth National Family Health Survey;²⁴ conducted over 2015 to 2016 in India. The Fourth National Family Health Survey was conducted over all 640 districts of India (according to Census of India 2011 listing),²⁵ and included men aged 15 to 54 years and women aged 15 to 49 years. For consistency in our study, we included participants aged 18 to 49 years. Households within each district were selected to participate in the survey by two-stage cluster random sampling, stratified by rural versus urban areas. Primary sampling units, selected using probability proportional to population size, were defined as villages in rural areas and census enumeration blocks in urban areas. After sitting calmly for 5 minutes, the blood pressure of participants was measured three times, with at least 5 minutes between each measurement, in the left upper arm using the Omron HEM-8712 monitor. All blood pressure measurements were recorded in millimetres of mercury (mm Hg).

Hypertension guidelines

The six different guidelines that we used in this study for the calculation of hypertension prevalence are published by the European Society of Cardiology,⁷ the Government of India,⁸ the American College of Cardiology/American Heart Association,⁹ the National Institute for Health and Clinical Excellence/British and Irish Hypertension Society,¹⁰ the Eighth Joint National Committee¹¹ and the International Society of Hypertension.¹² The latter two guidelines are identical in terms of diagnosis of raised blood pressure. All six guidelines are used in India for the diagnosis and treatment of hypertension; although the exact proportion of health-care providers across India that adhere to any particular guideline is not known, the proportion of health-care providers adhering to specific guidelines was investigated within a single private hospital¹³ and among attendees of a cardiology conference.¹⁴

The number of readings taken, the number of visits required by the patient and the blood pressure at which hypertension is diagnosed (and pharmacological antihypertensive treatment initiated) for each of these six guidelines are listed in Table 1. Although all the listed guidelines recommend the measurement of blood pressure from at least two or three readings, it is general practice in India to take only a single blood pressure reading.²⁶ A patient is defined as having raised blood pressure if their blood pressure is categorized as Stage 1 or Grade 1 hypertension or higher according to the different guidelines in Table 1. A patient is defined as hypertensive if they have raised blood pressure, have confirmed at the time of the survey that they were taking prescribed medicine to control blood pressure, or if they had previously received at least two diagnoses of raised blood pressure or hypertension.

Statistical analysis

From the sample, we excluded participants having at least one missing blood pressure measurement or having unfeasible (i.e. systolic blood pressure < 30 mm Hg or < diastolic blood pressure) readings. We calculated the proportion of individuals within various blood pressure categories for age groups 18 to 34, 35 to 49 and 18 to 49 years of age for all six guidelines. We applied sampling weights and adjusted confidence intervals (CIs) at the primary sampling unit level to obtain nationally representative estimates with precise CIs.

To calculate prevalence, we defined participants having hypertension if they had stage I/grade I or higher blood pressure, taking prescribed medicine to control blood pressure or being informed at least twice by the health professional that they had raised blood pressure or hypertension. We estimated the total population within each age group from Census of India 2011 age distribution data,²⁷ multiplied by World Bank Indian population estimates for the year 2017.²⁸

We calculated the number of individuals across India within each category for each guideline by multiplying the proportion within each blood pressure category according to the Fourth National Family Health Survey by the calculated population within each age group. To confirm that the exclusion of participants did not cause significant difference in terms of age, sex and place of residence in the final data set, we performed a sensitivity analysis by comparing prevalence estimates from the clean data set with those from the full data set. We performed all analyses using Stata software, version 15.0 (StataCorp, College Station, United States of America).

Ethics

The Fourth National Family Health Survey obtained ethical clearance from the Ethics Committee of the International Institute for Population Sciences.²⁴ No specific permission was required for our study, as we conducted a secondary analysis of publicly available data.

Results

We obtained data on 797 161 individuals from the survey. We excluded 45 691 patients with missing data and 1594 participants with unusual blood pressure measurements.²⁴ Of the 749 876 eligible participants, 651 605 (86.9%) were women and 98 271 (13.1%) were men, and 529 899 (70.7%) of individuals resided in rural areas. Our study sample comprises 439 414 (58.6%) individuals 18 to 34 years of age and 310 462 (41.4%) individuals 35 to 49 years of age. The sensitivity analysis showed that the exclusion of participants with missing or unfeasible readings did not cause a difference in the final data set.

We observe that the Government of India and the American College of Cardiology/American Heart Association guidelines consistently yield the lowest and highest prevalence of measured raised blood pressure, respectively (Table 2). For the combined age group, in order of increasing prevalence the weighted proportion of the population classified as having raised blood pressure is: 7.5% (95% CI: 7.4 to 7.7; Government of India guidelines); 10.1% (95% CI: 10.0 to 10.2; European Society of Cardiology/European Society of Hypertension guidelines); 13.1% (95% CI: 13.1 to 13.3; Eighth Joint National Committee and International Society of Hypertension guidelines); 19.4% (95% CI: 19.3 to 19.6; National Institute for Health and Clinical Excellence/British and Irish Hypertension Society guidelines); and 40.1% (95% CI: 39.7 to 40.7; American College of Cardiology/American Heart Association guidelines; Table 2). Among the group 18 to 34 years of age, the Government of India and
the American College of Cardiology/American Heart Association guidelines yielded proportions of the population with raised blood pressure of 3.4% (95% CI: 3.3 to 3.5) and 30.3% (95% CI: 30.2 to 30.5), respectively. Among the older age group, the lowest and highest proportions were calculated as 13.8% (95% CI: 13.7 to 14.0; Government of India guidelines) and 55.3% (95% CI: 55.2 to 55.5; American College of Cardiology/American Heart Association guidelines), respectively. Following the guidelines set by the Government of India, we estimate 48 million Indians have raised blood pressure; if the American College of Cardiology/American Heart Association guidelines are followed, this number is 253 million (Table 3).

We also observe an increase in the weighted proportion of the population classified as having raised blood pressure when only a single blood pressure reading (i.e. the first reading taken) is considered.

Table 1. Guidelines for definition of raised blood pressure used in comparison study, India

| No. of readings by guideline | Reading considered | Hypertension diagnosis | Blood pressure categorya | Blood pressure (mm Hg) |
|-----------------------------|--------------------|------------------------|--------------------------|------------------------|
|                             |                    |                        | Systolic                 | Diastolic              |
| **European Society of Cardiology/European Society of Hypertension**7 | At least three (if different by ≥ 10 mm Hg, at least four) | Average of last two readings | Other than Grade 3, two visits required | Normal<sup>b</sup> | <120 | <80 |
|                             |                    |                        |                           | Normal | 120 to 129 | 80 to 84 |
|                             |                    |                        |                           | High normal | 130 to 139 | 85 to 89 |
|                             |                    |                        | Grade 1 hypertension | Grade 1 hypertension | 140 to 159 | 90 to 99 |
|                             |                    |                        | Grade 2 hypertension | Grade 2 hypertension | 160 to 179 | 100 to 109 |
|                             |                    |                        | Grade 3 hypertension | Grade 3 hypertension | ≥ 180 | ≥ 110 |
|                             |                    |                        | Isolated systolic hypertension | Isolated systolic hypertension | ≥ 140 | <90 |
| **Government of India**<sup>a</sup> | At least two (if different by ≥ 5 mm Hg, at least three) | Lowest | Other than Grade 3, two visits required | Optimal<sup>b</sup> | <120 | <80 |
|                             |                    |                        |                           | Normal | 120 to 129 | 80 to 84 |
|                             |                    |                        |                           | High normal | 130 to 139 | 85 to 89 |
|                             |                    |                        | Grade 1 hypertension | Grade 1 hypertension | 140 to 159 | 90 to 99 |
|                             |                    |                        | Grade 2 hypertension | Grade 2 hypertension | 160 to 179 | 100 to 109 |
|                             |                    |                        | Grade 3 hypertension | Grade 3 hypertension | ≥ 180 | ≥ 110 |
|                             |                    |                        | Isolated systolic hypertension | Isolated systolic hypertension | ≥ 140 | <90 |
|                             |                    |                        | Hypertensive urgency | Hypertensive urgency | > 180 | > 110 |
|                             |                    |                        | Hypertensive emergency | Hypertensive emergency | > 180 | > 110 to 120 |
| **American College of Cardiology/American Heart Association**9 | At least two | Average | Two visits or more | Normal<sup>b</sup> | <120 | <80 |
|                             |                    |                        |                           | Elevated | 120 to 129 | 80 to 84 |
|                             |                    |                        | Stage 1 hypertension | Stage 1 hypertension | 130 to 139 | 80 to 89 |
|                             |                    |                        | Stage 2 hypertension | Stage 2 hypertension | ≥ 140 | ≥ 90 |
| **National Institute for Health and Clinical Excellence/British and Irish Hypertension Society**<sup>10</sup> | At least two (if readings different, at least three) | Average of last two readings | Two visits or more | Normal<sup>b</sup> | <135 | <85 |
|                             |                    |                        | Stage 1 hypertension | Stage 1 hypertension | ≥ 135 | ≥ 85 |
|                             |                    |                        | Stage 2 hypertension | Stage 2 hypertension | ≥ 150 | ≥ 95 |
|                             |                    |                        | Severe hypertension | Severe hypertension | ≥ 180 | ≥ 110 |
| **Eighth Joint National Committee**<sup>11</sup> | At least two | Average | Two visits or more | Normal<sup>b</sup> | <120 | <80 |
|                             |                    |                        | Prehypertension | Prehypertension | 120 to 139 | 80 to 89 |
|                             |                    |                        | Stage 1 hypertension | Stage 1 hypertension | 140 to 159 | 90 to 99 |
|                             |                    |                        | Stage 2 hypertension | Stage 2 hypertension | ≥ 160 | ≥ 100 |
| **International Society of Hypertension**12 | At least two | Average | Two visits or more | Normal<sup>b</sup> | <120 | <80 |
|                             |                    |                        | Prehypertension | Prehypertension | 120 to 139 | 80 to 89 |
|                             |                    |                        | Stage 1 hypertension | Stage 1 hypertension | 140 to 159 | 90 to 99 |
|                             |                    |                        | Stage 2 hypertension | Stage 2 hypertension | ≥ 160 | ≥ 100 |

Hg: mercury.

<sup>a</sup> Bold formatting indicates the blood pressure category at which medical treatment is initiated.

<sup>b</sup> Categories for which both systolic and diastolic blood pressure measurements of less than threshold are required; patients are assigned to other categories if either of their systolic or diastolic blood pressure measurement is within the given limit.

<sup>c</sup> Medical treatment initiated only if the patient has a Framingham risk score (risk of developing cardiovascular disease over the next 10 years) of ≥ 10%.
Table 2. Proportion of population with a blood pressure level according to category, guideline and reading, India, 2015–2016

| Blood pressure category by guideline | If guidelines followed | Weighted % (95% CI)* | If only first reading considered |
|-------------------------------------|-----------------------|----------------------|-------------------------------|
|                                     | 18 to 34 years        | 35 to 49 years       | 18 to 49 years                |
| European Society of Cardiology/European Society of Hypertension |                      |                      |                               |
| Optimal                             | 66.0 (65.7 to 66.2)   | 41.5 (41.1 to 41.8)  | 56.4 (56.1 to 56.6)           |
| Normal                              | 20.4 (20.1 to 20.6)   | 24.7 (24.5 to 25.0)  | 22.1 (21.9 to 22.3)           |
| High normal                         | 8.4 (8.3 to 8.6)      | 16.1 (15.9 to 16.4)  | 11.5 (11.3 to 11.6)           |
| Grade 1 hypertension                | 3.9 (3.8 to 4.0)      | 11.1 (11.1 to 11.5)  | 6.8 (6.7 to 6.9)              |
| Grade 2 hypertension                | 0.6 (0.6 to 0.7)      | 3.1 (3.0 to 3.2)     | 1.6 (1.6 to 1.7)              |
| Grade 3 hypertension                | 0.1 (0.1 to 0.2)      | 1.2 (1.1 to 1.2)     | 0.5 (0.5 to 0.6)              |
| Isolated systolic hypertension      | 0.6 (0.5 to 0.6)      | 2.0 (2.0 to 2.1)     | 1.1 (1.1 to 1.2)              |
| Government of India                  |                       |                      |                               |
| Optimal                             | 73.7 (73.4 to 73.9)   | 49.2 (48.8 to 49.5)  | 64.1 (63.8 to 64.3)           |
| Normal                              | 17.1 (16.9 to 17.3)   | 23.9 (23.6 to 24.1)  | 19.7 (19.5 to 19.9)           |
| High normal                         | 5.8 (5.7 to 5.9)      | 13.1 (12.9 to 13.3)  | 8.7 (8.5 to 8.8)              |
| Grade 1 hypertension                | 2.6 (2.6 to 2.7)      | 8.8 (8.7 to 9.0)     | 5.1 (5.0 to 5.2)              |
| Grade 2 hypertension                | 0.4 (0.4 to 0.4)      | 2.4 (2.3 to 2.5)     | 1.2 (1.1 to 1.2)              |
| Grade 3 hypertension                | 0.1 (0.1 to 0.1)      | 0.8 (0.8 to 0.9)     | 0.4 (0.4 to 0.4)              |
| Isolated systolic hypertension      | 0.3 (0.3 to 0.3)      | 1.8 (1.7 to 1.9)     | 0.9 (0.9 to 0.9)              |
| American College of Cardiology/American Heart Association |                      |                      |                               |
| Normal                              | 63.3 (63.0 to 63.6)   | 38.7 (38.3 to 39.0)  | 53.6 (53.4 to 53.9)           |
| Elevated                            | 6.4 (6.3 to 6.5)      | 6.1 (5.9 to 6.2)     | 6.3 (6.2 to 6.4)              |
| Stage 1 hypertension                | 24.3 (24.3 to 24.8)   | 36.2 (35.9 to 36.5)  | 29.1 (28.9 to 29.3)           |
| Stage 2 hypertension                | 5.8 (5.7 to 5.9)      | 19.1 (18.8 to 19.3)  | 11.0 (10.9 to 11.1)           |
| Stage 1 with Framingham risk score of ≥ 10% | 8.4 (8.3 to 8.6) | 54.1 (53.7 to 54.4) | 30.4 (30.1 to 30.6) |
| National Institute for Health and Clinical Excellence/British and Irish Hypertension Society |                      |                      |                               |
| Normal                              | 87.9 (87.7 to 88.1)   | 69.2 (68.9 to 69.5)  | 80.6 (80.4 to 80.8)           |
| Stage 1 hypertension                | 10.1 (9.9 to 10.3)    | 22.0 (21.7 to 22.2)  | 14.7 (14.6 to 14.9)           |
| Stage 2 hypertension                | 1.9 (1.8 to 1.9)      | 7.7 (7.5 to 7.8)     | 4.1 (4.1 to 4.2)              |
| Severe hypertension                 | 0.2 (0.1 to 0.2)      | 1.2 (1.1 to 1.3)     | 0.6 (0.5 to 0.6)              |

(continues...)
considered, compared with measuring blood pressure from several readings as recommended by the guidelines (Table 2). If the proportion is based on first reading only, the guidelines published by the European Society of Cardiology/European Society for Hypertension and by the Government of India yield the same results. The increase in the proportion is higher in the younger compared with the older age group for all guidelines. Specifically, when we consider only the first reading for blood pressure categorization, the proportion of the population in the combined age group with raised blood pressure according to the Government of India guidelines increases by 8.9 percentage-points to 16.5% (95% CI: 16.5 to 16.7). According to the American College of Cardiology/American Heart Association guidelines, the proportion increases by 8.5 percentage-points to 48.6% (95% CI: 48.5 to 48.8) when only the first blood pressure reading is considered.

By neglecting to follow any guidelines precisely and by basing diagnosis on a single reading of blood pressure only, a total of 56 million would be erroneously categorized as hypertensive instead of normotensive following the American College of Cardiology/American Heart Association guidelines (Table 3). The largest increase in patients misdiagnosed with raised blood pressure from a single reading (65 million; Table 3) is observed for the National Institute for Health and Clinical Excellence/British and Irish Hypertension Society guidelines.

Table 4 shows the national hypertension prevalence according to various guidelines. For the combined age group, following the American College of Cardiology/American Heart Association guidelines yields a hypertension prevalence (44.7%, 95% CI: 44.4 to 45.0) three times higher than that calculated according to the Government of India guidelines (15.8%, 95% CI: 15.5 to 16.0).

Discussion

This study compares the difference in hypertension prevalence when using six hypertension management guidelines in India. Our findings, that prevalence of hypertension varies according to guidelines followed and according to the number of blood pressure readings taken, are in concordance with other studies.7,30,31

---

**Table 4**

| Blood pressure category by guideline | Weighted % (95% CI)** | If guidelines followed | If only first reading considered |
|--------------------------------------|-----------------------|------------------------|---------------------------------|
| Normal                               | 59.5 (59.2 to 59.8)   | 59.5 (59.2 to 59.8)   | 59.5 (59.2 to 59.8)             |
| Prehypertension                      | 33.1 (32.9 to 33.4)   | 33.1 (32.9 to 33.4)   | 33.1 (32.9 to 33.4)             |
| Stage 1 hypertension                 | 6.2 (6.1 to 6.3)      | 6.2 (6.1 to 6.3)      | 6.2 (6.1 to 6.3)                |
| Stage 2 hypertension                 | 1.1 (1.1 to 1.2)      | 1.1 (1.1 to 1.2)      | 1.1 (1.1 to 1.2)                |
| Normal                               | 59.5 (59.2 to 59.8)   | 59.5 (59.2 to 59.8)   | 59.5 (59.2 to 59.8)             |
| Prehypertension                      | 33.1 (32.9 to 33.4)   | 33.1 (32.9 to 33.4)   | 33.1 (32.9 to 33.4)             |
| Stage 1 hypertension                 | 6.2 (6.1 to 6.3)      | 6.2 (6.1 to 6.3)      | 6.2 (6.1 to 6.3)                |
| Stage 2 hypertension                 | 1.1 (1.1 to 1.2)      | 1.1 (1.1 to 1.2)      | 1.1 (1.1 to 1.2)                |

---

**Note:** Some columns do not add up to 100% because of rounding of individual percentages to a single decimal point. Framingham risk score indicates risk of developing cardiovascular disease within 10 years or ≥10% as well as systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 80 mm Hg.
Table 3. Number of people categorized by blood pressure level, guidelines and readings, India, 2015–2016

| Blood pressure category by guideline | Population in millions (95% CI) | Difference in millions |
|-------------------------------------|---------------------------------|------------------------|
|                                     | 18 to 34 years | 35 to 49 years | 18 to 49 years | 18 to 34 years | 35 to 49 years | 18 to 49 years |
| European Society of Cardiology/European Society of Hypertension | | | | | | |
| Optimal | 265 (254 to 257) | 101 (100 to 102) | 365 (354 to 357) | 207 (205 to 208) | 76 (76 to 77) | 282 (280 to 284) | −49 | −25 | −73 |
| Normal | 79 (78 to 80) | 60 (60 to 61) | 139 (138 to 140) | 89 (89 to 90) | 55 (55 to 56) | 145 (144 to 146) | 11 | −5 | 6 |
| High normal | 33 (32 to 33) | 39 (39 to 40) | 72 (71 to 73) | 52 (51 to 53) | 48 (47 to 48) | 100 (99 to 101) | 19 | 8 | 27 |
| Grade 1 hypertension | 15 (15 to 16) | 27 (27 to 28) | 43 (42 to 44) | 28 (28 to 29) | 39 (39 to 40) | 68 (67 to 69) | 13 | 12 | 25 |
| Grade 2 hypertension | 2 (2 to 3) | 8 (7 to 8) | 10 (10 to 10) | 5 (5 to 5) | 12 (11 to 12) | 16 (16 to 17) | 2 | 4 | 6 |
| Grade 3 hypertension | 1 (1 to 1) | 3 (3 to 3) | 3 (3 to 4) | 2 (1 to 2) | 5 (5 to 5) | 6 (6 to 7) | 1 | 2 | 3 |
| Isolated systolic hypertension | 2 (2 to 2) | 5 (5 to 5) | 7 (7 to 7) | 5 (5 to 5) | 8 (8 to 8) | 13 (13 to 13) | 3 | 3 | 6 |
| Government of India | | | | | | |
| Optimal | 285 (284 to 286) | 120 (119 to 120) | 404 (402 to 406) | 207 (205 to 208) | 76 (76 to 77) | 282 (280 to 284) | −79 | −43 | −122 |
| Normal | 66 (65 to 67) | 58 (57 to 59) | 124 (123 to 126) | 89 (89 to 90) | 55 (55 to 56) | 145 (144 to 146) | 23 | −3 | 21 |
| High normal | 23 (22 to 23) | 31 (31 to 32) | 55 (54 to 55) | 52 (51 to 53) | 48 (47 to 48) | 100 (99 to 101) | 29 | 16 | 45 |
| Grade 1 hypertension | 10 (10 to 11) | 21 (21 to 22) | 32 (31 to 33) | 28 (28 to 29) | 39 (39 to 40) | 68 (67 to 69) | 18 | 18 | 36 |
| Grade 2 hypertension | 2 (1 to 2) | 6 (6 to 6) | 7 (7 to 8) | 5 (5 to 5) | 12 (11 to 12) | 16 (16 to 17) | 3 | 6 | 9 |
| Grade 3 hypertension | 0 (0 to 0) | 2 (2 to 2) | 2 (2 to 3) | 2 (1 to 2) | 5 (5 to 5) | 6 (6 to 7) | 1 | 3 | 4 |
| Isolated systolic hypertension | 1 (1 to 1) | 4 (4 to 5) | 6 (5 to 6) | 5 (5 to 5) | 8 (8 to 8) | 13 (13 to 13) | 4 | 4 | 7 |
| American College of Cardiology/American Heart Association | | | | | | |
| Normal | 245 (244 to 246) | 94 (93 to 95) | 338 (337 to 340) | 207 (205 to 208) | 76 (76 to 77) | 282 (280 to 284) | −38 | −18 | −56 |
| Elevated | 25 (24 to 25) | 15 (14 to 15) | 40 (39 to 40) | 28 (27 to 28) | 14 (14 to 15) | 42 (41 to 43) | 3 | 0 | 3 |
| Stage 1 hypertension | 95 (94 to 96) | 88 (87 to 89) | 183 (182 to 185) | 114 (113 to 115) | 89 (88 to 89) | 202 (201 to 204) | 19 | 1 | 19 |
| Stage 2 hypertension | 22 (22 to 23) | 46 (46 to 47) | 69 (68 to 70) | 39 (39 to 40) | 64 (63 to 65) | 104 (103 to 105) | 17 | 17 | 34 |
| Stage 1 with Framingham risk score of ≥ 10% | 33 (32 to 33) | 132 (131 to 132) | 191 (190 to 193) | 42 (41 to 43) | 149 (148 to 150) | 229 (227 to 231) | 9 | 17 | 37 |
| National Institute for Health and Clinical Excellence/British and Irish Hypertension Society | | | | | | |
| Normal | 340 (340 to 341) | 168 (168 to 169) | 508 (507 to 509) | 304 (303 to 305) | 139 (138 to 140) | 443 (441 to 444) | −36 | −29 | −65 |
| Stage 1 hypertension | 39 (38 to 40) | 53 (53 to 54) | 93 (92 to 94) | 66 (65 to 67) | 70 (69 to 71) | 136 (135 to 138) | 27 | 17 | 44 |
| Stage 2 hypertension | 7 (7 to 8) | 19 (18 to 19) | 26 (26 to 27) | 15 (15 to 15) | 29 (29 to 30) | 44 (44 to 45) | 8 | 11 | 18 |
| Severe hypertension | 1 (1 to 1) | 3 (3 to 3) | 4 (3 to 4) | 2 (2 to 2) | 5 (5 to 5) | 7 (7 to 7) | 1 | 2 | 3 |

(continues . . .)
Another recent study compared hypertension prevalence in India according to the Seventh Joint National Committee and the American College of Cardiology/American Heart Association guidelines. Their observation is in concordance with ours, that is, that hypertension prevalence more than doubles when calculated according to the American College of Cardiology/American Heart Association guidelines compared with Eight Joint National Committee guidelines. The other study investigated hypertension prevalence in the age group 30 to 74 years and obtained a prevalence of 52.3% (95% CI: 51.9 to 52.8) according to the American College of Cardiology/American Heart Association guidelines, similar to our observation of 44.7%. Our findings also show that 30.4% (95% CI: 30.1 to 30.6) of individuals 18 to 49 years of age with Stage 1 hypertension (according to American College of Cardiology/American Heart Association guidelines) have a 10-year risk of developing cardiovascular disease equal to or more than 10%; this figure was calculated as 40.3% for the age group 30 to 74 years in the recent study.

Our study is more versatile, however, with a comparison of six guidelines for hypertension prevalence using both single and repetitive measurements.

Our study had several limitations. We may have overestimated hypertension prevalence by our definition of hypertension being based on blood pressure measurements taken during one occasion; a clinical diagnosis of hypertension requires raised blood pressure on at least two different occasions. Another limitation of our study is the lack of nationally representative data regarding use of hypertension guidelines by health-care providers in India. Finally, the questions asked in the Fourth National Family Health Survey did not allow us to investigate any connection between the prevalence of hypertension and lifestyle.

Our results show that the current use of several different guidelines in India results in inconsistent prevalence data, which could result in poor health outcomes. We therefore urge global bodies to discuss and propose a universal

| Blood pressure category | Population in millions (95% CI) | Difference in millions |
|-------------------------|--------------------------------|-----------------------|
| Eighth Joint National Committee | 18 to 49 years | | |
| Normal | 231 (229 to 232) | 87 (86 to 88) | 317 (315 to 319) | 207 (206 to 209) | 77 (76 to 77) | 283 (282 to 285) |
| Prehypertension | 128 (127 to 129) | 40 (39 to 40) | 64 (64 to 65) | 14 (13 to 14) | 8 (8 to 8) | 24 (24 to 25) |
| Stage 1 hypertension | 24 (24 to 25) | 4 (4 to 5) | 14 (13 to 14) | 0 | 0 | 0 |
| International Society of Hypertension | 18 to 49 years | | | |
| Normal | 231 (229 to 232) | 87 (86 to 88) | 317 (315 to 319) | 207 (206 to 209) | 77 (76 to 77) | 283 (282 to 285) |
| Prehypertension | 128 (127 to 129) | 40 (39 to 40) | 64 (64 to 65) | 14 (13 to 14) | 8 (8 to 8) | 24 (24 to 25) |
| Stage 1 hypertension | 24 (24 to 25) | 4 (4 to 5) | 14 (13 to 14) | 0 | 0 | 0 |

**Notes:**
- a Population in some combined age groups do not always equal the sum of the population in the two subgroups because of rounding to a single decimal point.
- b Framingham risk score (risk of developing cardiovascular disease within 10 years) ≥ 10% as well as diastolic blood pressure ≥ 90 mm Hg.
### Table 4. National hypertension prevalence by age group and guidelines, India, 2015–2016

| Guideline                                      | Weighted % (95% CI) | Population in millions (95% CI) |
|------------------------------------------------|---------------------|---------------------------------|
| If guidelines followed                        | If only first reading considered |
| 18 to 34 years                                 | 18 to 49 years       | 18 to 34 years                  | 18 to 49 years                  |
| European Society of Cardiology / European Society of Hypertensiona | 12.2 (11.9 to 12.5)  | 26.8 (26.5 to 27.2)             | 17.9 (17.7 to 18.2)             |
| Government of Indiaa                           | 10.6 (10.3 to 10.9)  | 23.8 (23.5 to 24.2)             | 15.8 (15.5 to 16.0)             |
| American College of Cardiology / American Heart Associationa | 35.2 (34.9 to 35.5)  | 59.6 (59.2 to 59.9)             | 44.7 (44.4 to 45.0)             |
| National Institute for Health and Clinical Excellence / British and Irish Hypertension Societya | 18.4 (18.1 to 18.7)  | 38.0 (37.6 to 38.3)             | 26.0 (25.8 to 26.3)             |
| Eighth Joint National Committeeb                | 14.1 (13.8 to 14.4)  | 30.1 (30.0 to 30.9)             | 20.5 (20.2 to 20.8)             |
| International Society of Hypertensionc        | 14.1 (13.8 to 14.4)  | 30.1 (30.0 to 30.9)             | 20.5 (20.2 to 20.8)             |

CI: confidence interval.

*a The population in some combined age groups do not always equal the sum of the population in the two subgroups because of rounding to a single decimal point.

**MD and SR contributed equally to this work.**

### Acknowledgements

Funding: Ashish Awasthi is supported by the Department of Science and Technology, Government of India, New Delhi, through INSPIRE Faculty program. No financial assistance was received in support of this study.

Competing Interests: None declared.

Guideline similar to the cut-off for body mass index, malnutrition, and anaemia. In our opinion, the European Society of Hypertension guidelines are most suited for India; these guidelines have the same definitions of blood pressure categories as the Government of India guidelines, but diagnosis is made from the last two readings (out of three) instead of the lowest reading (out of two or three). This recommendation is supported by two different studies. In our opinion, the European Society of Hypertension guidelines are most suited for India; these guidelines have the same definitions of blood pressure categories as the Government of India guidelines, but diagnosis is made from the last two readings (out of three) instead of the lowest reading (out of two or three). This recommendation is supported by two different studies.
Prevalence of the hypertension in function of different directives, Inde

Objectif : Déterminer l'effet de différentes directives de gestion de l'hypertension et de l'établissement d'un diagnostic à partir d'une seule mesure de la tension artérielle sur la prévalence de l'hypertension dans la population indienne.

Méthodes : Nous avons effectué une analyse secondaire des données collectées lors de la quatrième enquête nationale sur la santé des familles, de 2015 à 2016, dans tous les districts d'Inde. Nous avons calculé la part de la population, dans trois tranches d'âge différentes (18-34 ans, 35-49 ans et 18-49 ans) qui présentaient une tension artérielle élevée selon six directives différentes, et la manière dont la prévalence changeait si le diagnostic se fondait sur une seule mesure de la tension artérielle.

Résultats : Nous avons observé que les directives du gouvernement indien et celles de l'American College of Cardiology/American Heart Association donnaient systématiquement la prévalence la plus faible et la prévalence la plus élevée d'hypertension artérielle ; dans la tranche d'âge combinée, nous avons calculé que la part de la population classée comme souffrant d'hypertension s'élevait respectivement à 7.5% (intervalle de confiance (IC) de 95% : 7.4 à 7.7) et à 40.1% (IC de 95% : 39.7 à 40.7). En fondant le diagnostic uniquement sur une mesure de la tension artérielle, un total de 56 millions de personnes seraient classées à tort comme hypertendues selon les directives du gouvernement indien. Nous avons également montré que la prévalence de l'hypertension en Inde varie en fonction des directives auxquelles on se réfère ; dans la tranche d'âge combinée, la prévalence nationale de l'hypertension était trois fois plus élevée si l'on suivait les directives de l'American College of Cardiology/American Heart Association que celles du gouvernement indien.

Conclusion : Pour optimiser la pratique clinique, les prestataires de soins doivent suivre des méthodes de diagnostic de l'hypertension éprouvées et universellement admises.
Резюме

Зависимость уровня распространенности гипертонии в Индии от различных руководящих принципов

Цель
Определение влияния различных руководящих принципов по ведению больных с артериальной гипертонией и постановки диагноза по однократному измерению артериального давления на показатели распространенности гипертонии среди населения Индии.

Методы
Авторы провели дополнительный анализ данных, полученных в рамках четвертого национального опроса о здоровье семьи, который проводился в 2015–2016 годах во всех регионах Индии. Была рассчитана доля лиц с повышенным артериальным давлением в популяции трех возрастных групп (от 18 до 34 лет, от 35 до 49 лет и от 18 до 49 лет) в соответствии с шестью различными руководящими принципами, а также продемонстрировано изменение показателя распространенности гипертонии, если диагностика опиралась на однократное измерение артериального давления.

Результаты
Авторы обнаружили, что руководящие принципы Правительства Индии и Американской коллегии кардиологов или Американской коллегии сердца в результате неизменно дают минимальный и максимальный показатели распространенности повышенного артериального давления, в комбинированной возрастной группе по расчетам авторов, доля населения с повышенным артериальным давлением составила соответственно 7,5% (95%-ДИ: 7,4–7,7) и 40,1% (95%-ДИ: 39,7–40,7). В случаях постановки диагноза на основании однократного измерения артериального давления 56 миллионам людей был бы ошибочно поставлен диагноз гипертонии на основании руководящих принципов Правительства Индии. Авторы также доказали, что уровень распространенности гипертонии в Индии зависит от того, каким руководящим принципом следуют врачи: в комбинированной возрастной группе национальный уровень распространенности гипертонии был в три раза выше при использовании руководящих принципов Американской коллегии кардиологов или Американской ассоциации сердца, чем при использовании руководящих принципов Правительства Индии.

Вывод
Для оптимизации текущей клинической практики работы врачей здравоохранения должны следовать всемирно признанным и научно обоснованным методам диагностики гипертонии.

References
1. Mehndiratta A, Sharma S, Gupta NP, Sankar MJ, Cluzeau F. Adapting clinical guidelines in India—a pragmatic approach. BMJ. 2017 11 17;359:j147. doi: http://dx.doi.org/10.1136/bmj.j147 PMID: 29150419
2. Berger D. Corruption ruins the doctor-patient relationship in India. BMJ. 2014 05 8;348(may08 3):g3169. doi: http://dx.doi.org/10.1136/bmj.g3169 PMID: 24812115
3. Nagpal N. Incidents of violence against doctors in India: Can these be prevented? Natl Med J India. 2017 Mar-Apr;30(2):97–100. PMID: 28816220
4. Beevers G, Lip GY, O'Brien E. ABC of hypertension: Blood pressure measurement. BMJ. 2001 Apr 28;322(7293):1043–7. doi: http://dx.doi.org/10.1136/bmj.322.7293.1043 PMID: 11325773
5. Figueiredo D, Azevedo A, Pereira M, de Barros H. Definition of hypertension: measurement of number of visits for blood pressure measurement. BMJ. 2012 Oct 30;345(e6359). doi: http://dx.doi.org/10.1136/bmj.e6359 PMID: 23136246
6. Handler J, Zhao Y, Egan BM. Impact of the number of blood pressure measurements on blood pressure classification in US adults: NHANES 1999-2008. J Clin Hypertens (Greenwich). 2012 Nov;14(11):751–9. doi: http://dx.doi.org/10.1111/jch.12000 PMID: 23136246
7. Williams B, Mancia G, Spering W, Agabiti Rosei E, Azizi M, Bumier M, et al.; ESC Scientific Document Group. 2018 ESC/ESH Guidelines for the management of arterial hypertension. Eur Heart J. 2018 Sep 1 39(33):3021–104. doi: http://dx.doi.org/10.1093/eurheartj/ehy339 PMID: 30165516
8. Association of Physicians of India. Indian guidelines on hypertension (I.G.H.) - III. 2013. J Assoc Physicians India. 2013 Feb;61(2) Suppl6–36. PMID: 24475694
9. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ ASCP/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Hypertension. 2018 06;71(6):1269–324. doi: http://dx.doi.org/10.1161/HYP.0000000000000266 PMID: 29133534
10. McCormack T, Krause T, O’Flynn N. Management of hypertension in adults in primary care: NICE guideline. Br J Gen Pract. 2012 Mar;62(596):163–4. doi: http://dx.doi.org/10.3399/bjgp12X630232 PMID: 22429432

Resumen

Prevalencia de hipertensión en función de las diferentes directrices, India

Objetivo
Determinar el efecto de las diferentes directrices para el tratamiento de la hipertensión y de basar el diagnóstico en una sola lectura de la presión arterial sobre la prevalencia de la hipertensión en la población indiana.

Métodos
Se realizó un análisis secundario de los datos adquiridos como parte de la Cuarta Encuesta Nacional de Salud Familiar, 2015–2016, en todos los distritos de la India. Se calculó la proporción de la población dentro de tres grupos de edad diferentes (de 18 a 34 años, de 35 a 49 años y de 18 a 49 años) con presión arterial elevada de acuerdo con seis directrices diferentes, y cómo la prevalencia cambió si el diagnóstico se basó en una sola medición de la presión arterial.

Resultados
Se observó que las directrices del Gobierno de la India y del Colegio Americano de Cardiología/Asociación Americana del Corazón arrojaron sistemáticamente la prevalencia más baja y más alta de presión arterial elevada; en el grupo de edad combinado, se calculó que la proporción de la población categorizada como con presión arterial elevada era de 7,5% (intervalo de confianza [IC] del 95%: 7,4 a 7,7) y 40,1% (IC del 95%: 39,7 a 40,7), respectivamente. Al basar el diagnóstico en una sola lectura de la presión arterial, un total de 56 millones de personas serían erróneamente clasificadas como hipertensivas según las directrices del Gobierno de la India. También se demostró que la prevalencia de la hipertensión en la India variaba según las directrices a las que se adhieren; en el grupo de edad combinado, la prevalencia nacional de la hipertensión era tres veces mayor cuando se seguía las directrices del Colegio Americano de Cardiología/Asociación Americana del Corazón en comparación con las del Gobierno de la India.

Conclusión
Para optimizar la práctica clínica actual, los profesionales de la atención de la salud deben seguir métodos universalmente acordados y basados en la evidencia para diagnosticar la hipertensión.
