

Prevalence, awareness, treatment, and control of hypertension in China: data from 1·7 million adults in a population-based screening study (China PEACE Million Persons Project)



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Summary

Background Hypertension is common in China and its prevalence is rising, yet it remains inadequately controlled. Few studies have the capacity to characterise the epidemiology and management of hypertension across many heterogeneous subgroups. We did a study of the prevalence, awareness, treatment, and control of hypertension in China and assessed their variations across many subpopulations.

Methods We made use of data generated in the China Patient-Centered Evaluative Assessment of Cardiac Events (PEACE) Million Persons Project from Sept 15, 2014, to June 20, 2017, a population-based screening project that enrolled around 1·7 million community-dwelling adults aged 35–75 years from all 31 provinces in mainland China. In this population, we defined hypertension as systolic blood pressure of at least 140 mm Hg, or diastolic blood pressure of at least 90 mm Hg, or self-reported antihypertensive medication use in the previous 2 weeks. Hypertension awareness, treatment, and control were defined, respectively, among hypertensive adults as a self-reported diagnosis of hypertension, current use of antihypertensive medication, and blood pressure of less than 140/90 mm Hg. We assessed awareness, treatment, and control in 264 475 population subgroups—defined a priori by all possible combinations of 11 demographic and clinical factors (age [35–44, 45–54, 55–64, and 65–75 years], sex [men and women], geographical region [western, central, and eastern China], urbanity [urban vs rural], ethnic origin [Han and non-Han], occupation [farmer and non-farmer], annual household income [$<$ ¥10 000, ¥10 000–50 000, and \geq ¥50 000], education [primary school and below, middle school, high school, and college and above], previous cardiovascular events [yes or no], current smoker [yes or no], and diabetes [yes or no]), and their associations with individual and primary health-care site characteristics, using mixed models.

Findings The sample contained 1 738 886 participants with a mean age of 55·6 years (SD 9·7), 59·5% of whom were women. 44·7% (95% CI 44·6–44·8) of the sample had hypertension, of whom 44·7% (44·6–44·8) were aware of their diagnosis, 30·1% (30·0–30·2) were taking prescribed antihypertensive medications, and 7·2% (7·1–7·2) had achieved control. The age-standardised and sex-standardised rates of hypertension prevalence, awareness, treatment, and control were 37·2% (37·1–37·3), 36·0% (35·8–36·2), 22·9% (22·7–23·0), and 5·7% (5·6–5·7), respectively. The most commonly used medication class was calcium-channel blockers (55·2%, 55·0–55·4). Among individuals whose hypertension was treated but not controlled, 81·5% (81·3–81·6) were using only one medication. The proportion of participants who were aware of their hypertension and were receiving treatment varied significantly across subpopulations; lower likelihoods of awareness and treatment were associated with male sex, younger age, lower income, and an absence of previous cardiovascular events, diabetes, obesity, or alcohol use (all $p < 0\cdot01$). By contrast, control rate was universally low across all subgroups ($< 30\cdot0\%$).

Interpretation Among Chinese adults aged 35–75 years, nearly half have hypertension, fewer than a third are being treated, and fewer than one in twelve are in control of their blood pressure. The low number of people in control is ubiquitous in all subgroups of the Chinese population and warrants broad-based, global strategy, such as greater efforts in prevention, as well as better screening and more effective and affordable treatment.

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Introduction

Blood pressure control is a national public health priority in China.¹ Surveys in China show that high blood pressure is common, but hypertension treatment and control rates are less than 50% and 20%, respectively, across different studies.^{2–6} Findings from previous studies have estimated China's average burden of hypertension,^{2–9} but national

data on hypertension treatment are scarce, and how hypertension awareness, treatment, and control rates vary geographically and across population subgroups is uncertain. Because of their small sample sizes, previous studies examined hypertension measures in only a few subgroups, and to our knowledge none had the capacity to create a wide variety of discrete subgroups to investigate

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Abstract

Background- Hypertension is common in China and its prevalence is rising, yet it remains inadequately controlled. Few studies have the capacity to characterise the epidemiology and management of hypertension across many heterogeneous subgroups. We did a study of the prevalence, awareness, treatment, and control of hypertension in China and assessed their variations across many subpopulations.

Methods- We made use of data generated in the China Patient-Centered Evaluative Assessment of Cardiac Events (PEACE) Million Persons Project from Sept 15, 2014, to June 20, 2017, a population-based screening project that enrolled around 1.7 million community-dwelling adults aged 35–75 years from all 31 provinces in mainland China. In this population, we defined hypertension as systolic blood pressure of at least 140 mm Hg, or diastolic blood pressure of at least 90 mm Hg, or self-reported antihypertensive medication use in the previous 2 weeks. Hypertension awareness, treatment, and control were defined, respectively, among hypertensive adults as a self-reported diagnosis of hypertension, current use of antihypertensive medication, and blood pressure of less than 140/90 mm Hg. We assessed awareness, treatment, and control in 264 475 population subgroups—defined a priori by all possible combinations of 11 demographic and clinical factors (age [35–44, 45–54, 55–64, and 65–75 years], sex [men and women], geographical region [western, central, and eastern China], urbanity [urban vs rural], ethnic origin [Han and non-Han], occupation [farmer and non-farmer], annual household income [$< \text{¥}10\,000$, $\text{¥}10\,000\text{--}50\,000$, and $\geq \text{¥}50\,000$], education [primary school and below, middle school, high school, and college and above], previous cardiovascular events [yes or no], current smoker [yes or no], and diabetes [yes or no]), and their associations with individual and primary health-care site characteristics, using mixed models.

Findings- The sample contained 1 738 886 participants with a mean age of 55.6 years (SD 9.7), 59.5% of whom were women. 44.7% (95% CI 44.6–44.8) of the sample had hypertension, of whom 44.7% (44.6–44.8) were aware of their diagnosis, 30.1% (30.0–30.2) were taking prescribed antihypertensive medications, and 7.2% (7.1–7.2) had achieved control. The age-standardised and sex-standardised rates of hypertension prevalence, awareness, treatment, and control were 37.2% (37.1–37.3), 36.0% (35.8–36.2), 22.9% (22.7–23.0), and 5.7% (5.6–5.7), respectively. The most commonly used medication class was calcium-channel blockers (55.2%, 55.0–55.4). Among individuals whose hypertension was treated but not controlled, 81.5% (81.3–81.6) were using only one medication. The proportion of participants who were aware of their hypertension and were receiving treatment varied significantly across subpopulations; lower likelihoods of awareness and treatment were associated with male sex, younger age, lower income, and an absence of previous cardiovascular events, diabetes, obesity, or alcohol use (all $p < 0.01$). By contrast, control rate was universally low across all subgroups ($< 30.0\%$).

Interpretation- Among Chinese adults aged 35–75 years, nearly half have hypertension, fewer than a third are being treated, and fewer than one in twelve are in control of their blood pressure. The low number of people in control is ubiquitous in all subgroups of the Chinese population and warrants broad-based, global strategy, such as greater efforts in prevention, as well as better screening and more effective and affordable treatment.

Table 1. Characteristics of the study population by blood pressure levels

	Overall (n=1 738 886)	No hypertension (n=961 249)	All hypertension (n=777 637)	Stage 2 and above hypertension (n=264 822)
Prevalence	100.0% (100.0–100.0)	55.3% (55.2–55.4)	44.7% (44.6–44.8)	15.2% (15.2–15.3)
Age (years)				
35–39	77 668 (4.5%)	64 096 (6.7%)	13 572 (1.7%)	4 391 (1.7%)
40–44	184 594 (10.6%)	140 398 (14.6%)	44 196 (5.7%)	13 625 (5.1%)
45–49	256 922 (14.8%)	174 123 (18.1%)	82 799 (10.6%)	26 397 (10.0%)
50–54	304 060 (17.5%)	177 001 (18.4%)	127 059 (16.3%)	41 005 (15.5%)
55–59	248 157 (14.3%)	127 944 (13.3%)	120 213 (15.5%)	39 336 (14.9%)
60–64	299 540 (17.2%)	136 111 (14.2%)	163 429 (21.0%)	56 108 (21.2%)
65–69	224 432 (12.9%)	89 541 (9.3%)	134 891 (17.3%)	48 699 (18.4%)
70–75	143 513 (8.3%)	52 035 (5.4%)	91 478 (11.8%)	35 261 (13.3%)
Sex				
Men	703 860 (40.5%)	373 961 (38.9%)	329 899 (42.4%)	111 004 (41.9%)
Women	1 035 026 (59.5%)	587 288 (61.1%)	447 738 (57.6%)	153 818 (58.1%)
Urbanity				
Urban	675 339 (38.8%)	388 598 (40.4%)	286 741 (36.9%)	92 866 (35.1%)
Rural	1 063 547 (61.2%)	572 651 (59.6%)	490 896 (63.1%)	171 956 (64.9%)
Geographical region of China				
Eastern	576 110 (33.1%)	293 056 (30.5%)	283 054 (36.4%)	93 725 (35.4%)
Western	675 880 (38.9%)	401 480 (41.8%)	274 400 (35.3%)	98 380 (37.1%)
Central	486 896 (28.0%)	266 713 (27.7%)	220 183 (28.3%)	72 717 (27.5%)
Ethnic group				
Han	1 529 611 (88.0%)	833 104 (86.7%)	696 507 (89.6%)	233 173 (88.0%)
Non-Han	207 376 (11.9%)	127 268 (13.2%)	80 108 (10.3%)	31 255 (11.8%)
Unknown*	1 899 (0.1%)	877 (0.1%)	1 022 (0.1%)	394 (0.1%)
Education				
Primary school or lower	769 511 (44.3%)	387 976 (40.4%)	381 535 (49.1%)	135 535 (51.2%)
Middle school	558 880 (32.1%)	322 264 (33.5%)	236 616 (30.4%)	77 708 (29.3%)
High school	258 905 (14.9%)	154 575 (16.1%)	104 330 (13.4%)	33 203 (12.5%)
College or above	125 113 (7.2%)	81 215 (8.4%)	43 898 (5.6%)	14 430 (5.4%)
Unknown*	26 477 (1.5%)	15 219 (1.6%)	11 258 (1.4%)	3 946 (1.5%)

Table 1. Continued

	Overall (n=1 738 886)	No hypertension (n=961 249)	All hypertension (n=777 637)	Stage 2 and above hypertension (n=264 822)
Prevalence	100.0% (100.0–100.0)	55.3% (55.2–55.4)	44.7% (44.6–44.8)	15.2% (15.2–15.3)
Household income (¥/year)				
<10 000	390 948 (22.5%)	208 204 (21.7%)	182 744 (23.5%)	67 295 (25.4%)
10 000–50 000	958 190 (55.1%)	530 784 (55.2%)	427 406 (55.0%)	143 234 (54.1%)
>50 000	229 483 (13.2%)	131 188 (13.6%)	98 295 (12.6%)	30 146 (11.4%)
Unknown*	160 265 (9.2%)	91 073 (9.5%)	69 192 (8.9%)	24 147 (9.1%)
Marital status				
Married	1 615 561 (92.9%)	902 844 (93.9%)	712 717 (91.7%)	241 472 (91.2%)
Widowed, separated, divorced, or single	100 412 (5.8%)	45 531 (4.7%)	54 881 (7.1%)	19 595 (7.4%)
Unknown*	22 913 (1.3%)	12 874 (1.3%)	10 039 (1.3%)	3 755 (1.4%)
Health insurance status				
Insured	1 701 087 (97.8%)	939 638 (97.8%)	761 449 (97.9%)	259 234 (97.9%)
Uninsured	10 083 (0.6%)	6 099 (0.6%)	3 984 (0.5%)	1 306 (0.5%)
Unknown*	27 716 (1.6%)	15 512 (1.6%)	12 204 (1.6%)	4 282 (1.6%)
Medical history				
Myocardial infarction	12 649 (0.7%)	4 560 (0.5%)	8 089 (1.0%)	2 611 (1.0%)
Stroke	40 555 (2.3%)	10 879 (1.1%)	29 676 (3.8%)	11 568 (4.4%)
Cardiovascular disease risk factors				
Diabetes mellitus	105 379 (6.1%)	35 377 (3.7%)	70 002 (9.0%)	24 989 (9.4%)
Current smoker	340 219 (19.6%)	185 504 (19.3%)	154 715 (19.9%)	52 340 (19.8%)
Current drinker	418 818 (24.1%)	217 158 (22.6%)	201 660 (25.9%)	69 463 (26.2%)
Obesity (body-mass index ≥ 28 kg/m ²)	272 796 (15.7%)	98 203 (10.2%)	174 593 (22.5%)	66 675 (25.2%)

Data are % (95% CI) or n (%). No hypertension: systolic blood pressure <140 mm Hg, diastolic blood pressure <90 mm Hg, and not taking antihypertensive medication. All hypertension: systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg, or taking antihypertensive medication. Stage 2 and above hypertension: systolic blood pressure ≥ 160 mm Hg or diastolic blood pressure ≥ 100 mm Hg. *Participants either refused to answer the question or did not know the answer.

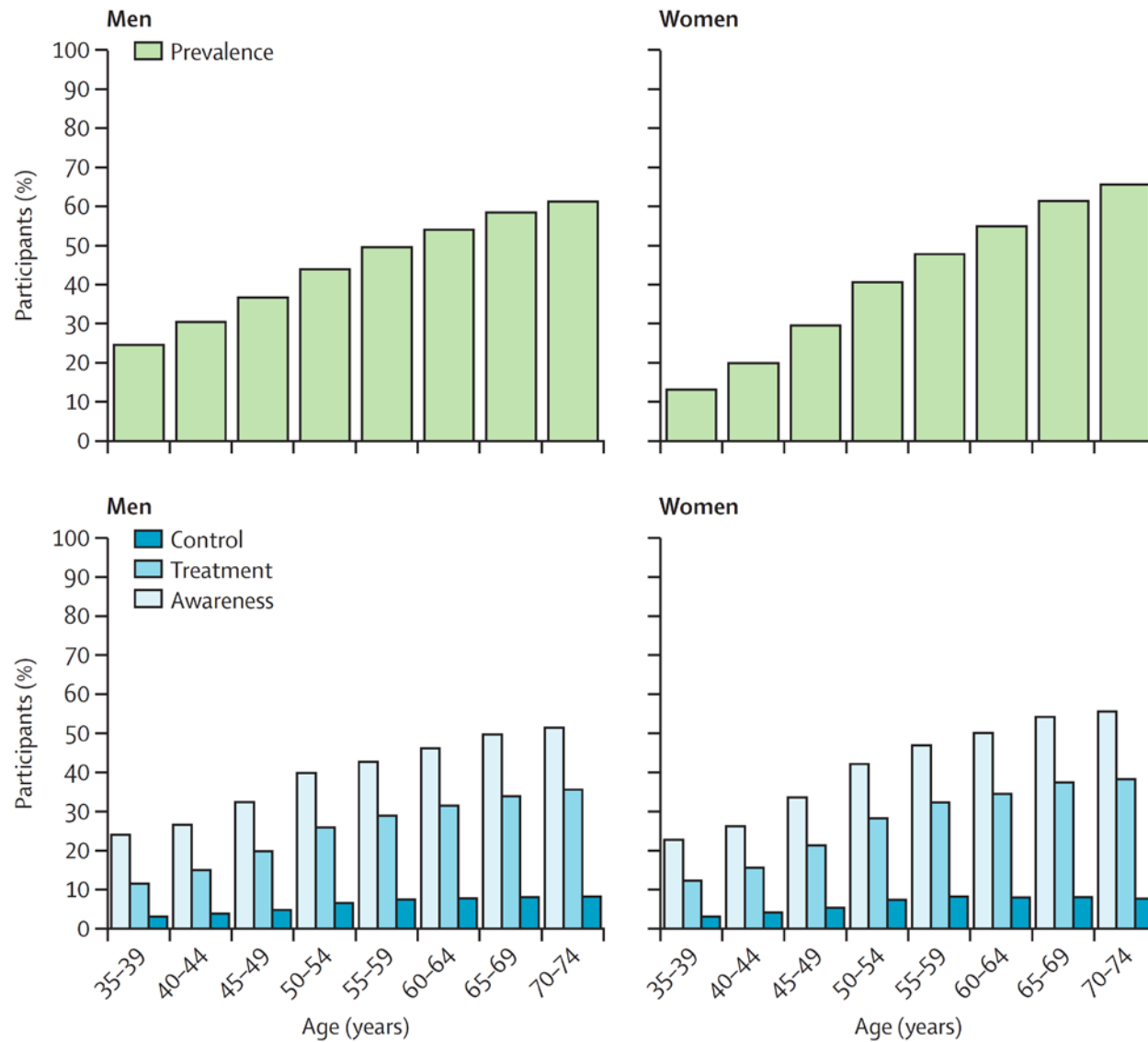


Figure 1: Prevalence, awareness, treatment, and control of hypertension among study participants

Data are shown stratified by age and sex.

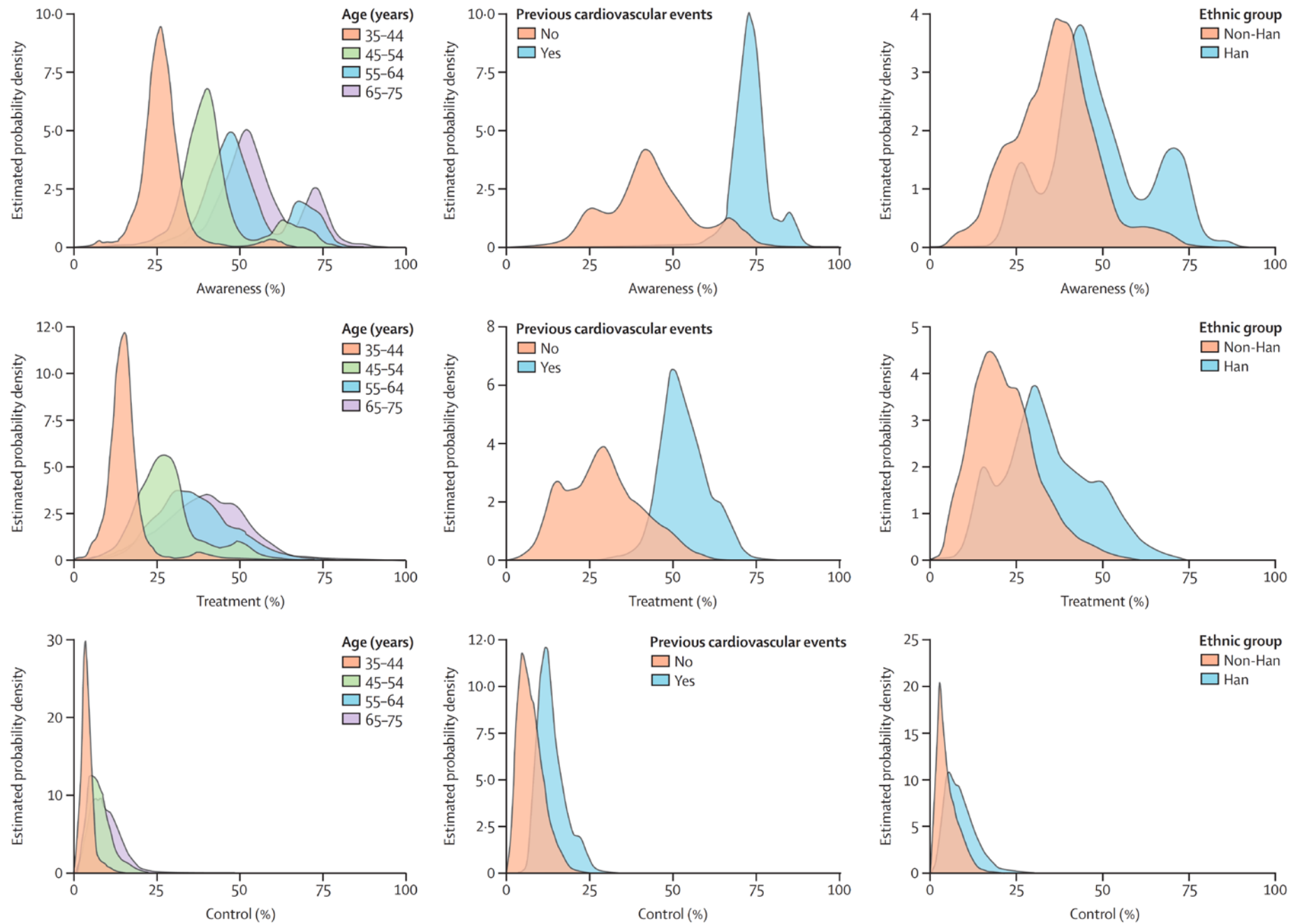


Figure 2: Density plots of awareness, treatment, and control of hypertension in 264 475 subgroups

Table 2: The most commonly used medications among treated adults with hypertension

	Overall	35–44 years	45–54 years	55–64 years	65–75 years
Among adults using one medication					
Nifedipine	49 034 (26.2%)	1398 (22.1%)	9926 (24.2%)	19 516 (26.5%)	18 194 (27.5%)
Amlodipine	14 390 (7.7%)	476 (7.5%)	3240 (7.9%)	5594 (7.6%)	5080 (7.7%)
Indapamide	11 598 (6.2%)	349 (5.5%)	2712 (6.6%)	4664 (6.3%)	3873 (5.9%)
Compound reserpine*	9944 (5.3%)	227 (3.6%)	2036 (5.0%)	3922 (5.3%)	3759 (5.7%)
Nitrendipine	9107 (4.9%)	193 (3.0%)	1565 (3.8%)	3490 (4.7%)	3859 (5.8%)
Total	187 320 (100%)	6335 (100%)	40 995 (100%)	73 749 (100%)	66 241 (100%)
Among adults using two medications					
Nifedipine and metoprolol	1684 (5.7%)	48 (4.2%)	369 (5.3%)	621 (5.5%)	646 (6.2%)
Captopril and nifedipine	1441 (4.8%)	52 (4.5%)	279 (4.0%)	582 (5.2%)	528 (5.0%)
Nifedipine and irbesartan	911 (3.1%)	42 (3.7%)	217 (3.1%)	342 (3.0%)	310 (3.0%)
Amlodipine besylate and irbesartan	893 (3.0%)	32 (2.8%)	235 (3.4%)	330 (2.9%)	296 (2.8%)
Nifedipine and telmisartan	711 (2.4%)	38 (3.3%)	183 (2.6%)	265 (2.4%)	225 (2.1%)
Total	29 792 (100%)	1143 (100%)	6913 (100%)	11 263 (100%)	10 473 (100%)
Among adults using three medications					
Nifedipine, metoprolol, and irbesartan	61 (2.5%)	3 (3.0%)	6 (1.1%)	23 (2.6%)	29 (3.1%)
Amlodipine, metoprolol, and irbesartan	54 (2.2%)	4 (4.0%)	9 (1.6%)	18 (2.1%)	23 (2.5%)
Nifedipine, telmisartan, and metoprolol	41 (1.7%)	0	13 (2.4%)	12 (1.4%)	16 (1.7%)
Total	2453 (100%)	99 (100%)	549 (100%)	876 (100%)	929 (100%)

Data are n (%) stratified by age and number of medications. *A fixed-dose combination drug consisting of reserpine (0.032 mg), hydrochlorothiazide (3.1 mg), potassium chloride (30 mg), dihydralazine sulfate (2.1 mg), and promethazine (2.1 mg).

Table 3. Individual characteristics associated with prevalence, awareness, treatment, and control of hypertension

	Prevalence	Awareness	Treatment	Control
Age (per 5 years)	1.35 (1.35–1.35)	1.20 (1.20–1.20)	1.19 (1.19–1.20)	1.07 (1.07–1.08)
Sex				
Men	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Women	0.97 (0.96–0.98)	1.18 (1.16–1.19)	1.16 (1.14–1.18)	1.11 (1.09–1.14)
Ethnic origin				
Non-Han	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Han	1.00 (0.98–1.01)	1.00 (0.97–1.02)	1.03 (1.01–1.06)	1.06 (1.01–1.12)
Marital status				
Not married	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Married	0.93 (0.92–0.94)	0.97 (0.95–0.99)	1.01 (0.99–1.03)	1.08 (1.05–1.12)
Annual household income (¥)				
<10 000	1 (ref)	1 (ref)	1 (ref)	1 (ref)
10 000–50 000	1.00 (0.98–1.01)	1.02 (1.01–1.04)	1.04 (1.02–1.06)	1.09 (1.06–1.12)
>50 000	1.00 (0.99–1.02)	1.09 (1.07–1.12)	1.10 (1.08–1.13)	1.22 (1.18–1.27)
Education level				
Lower than college	1 (ref)	1 (ref)	1 (ref)	1 (ref)
College or above	0.93 (0.91–0.96)	1.16 (1.12–1.21)	1.14 (1.10–1.19)	1.22 (1.15–1.30)
Occupation				
Not a farmer	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Farmer	0.96 (0.95–0.97)	0.90 (0.89–0.92)	0.83 (0.82–0.85)	0.80 (0.77–0.82)

Table 3. Continued

	Prevalence	Awareness	Treatment	Control
Health insurance status				
Insured	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Uninsured	0.99 (0.93–1.05)	0.78 (0.70–0.85)	0.76 (0.69–0.85)	0.75 (0.62–0.91)
Cardiovascular disease risk factors				
Current smoker	1.03 (1.02–1.04)	1.03 (1.02–1.05)	0.99 (0.98–1.01)	1.13 (1.10–1.16)
Current drinker	1.50 (1.48–1.52)	0.94 (0.93–0.96)	0.87 (0.85–0.88)	0.74 (0.72–0.77)
Diabetes mellitus	2.59 (2.57–2.62)	2.25 (2.21–2.29)	1.79 (1.76–1.83)	1.37 (1.34–1.41)
Obesity (body-mass index ≥28 kg/m ²)	1.80 (1.77–1.82)	1.66 (1.64–1.68)	1.55 (1.53–1.57)	1.02 (0.99–1.04)
Previous cardiovascular diseases	2.20 (2.15–2.24)	3.20 (3.12–3.29)	2.60 (2.54–2.67)	2.07 (2.00–2.13)
Geographical region of China				
Western	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Central	1.52 (1.44–1.60)	1.02 (0.93–1.11)	0.87 (0.77–0.98)	0.93 (0.80–1.08)
Eastern	1.34 (1.26–1.42)	1.10 (0.91–1.19)	1.08 (0.94–1.23)	1.06 (0.90–1.25)
Data are odds ratios (95% CI).				

Conclusion

- We conclude that hypertension is a major public health challenge in China. Despite its high prevalence, hypertension control in community-dwelling residents is poor, both overall and in diverse population subgroups.
- Our findings support broad-based opportunities to mitigate the burden of hypertension and suggest the need for a national strategy on hypertension prevention and control.