

Hypertension management based on general practice care in Shanghai, China

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Abstract

Background

Hypertension is one of the major public health problems in China. General practice (GP)-based disease management programs including hypertension have been widely disseminated in communities of Shanghai since 2010. This study was to evaluate the effectiveness on GP-management profile among patients with hypertension in urban communities of Shanghai, China.

Methods

A retrospective, community-based study using a primary care database from 2015 to 2017 was performed. The annual effective management of hypertension (≥ 4 times follow-up per year), blood pressure (BP) control rates, drug interventions, comorbidities burden were analyzed, respectively. Logistic regression analysis was used to determine the association between factors and uncontrolled BP.

Results

From 2015 to 2017, the effective management rate increased from 83.6–95.1%. Among them, drug treatment rates and BP control rates displayed a growing trend ($P < 0.001$), reached 94.1% and 80.6% in 2017, respectively. The medication of antihypertensive drugs was dominated by calcium channel blocker (CCB) and angiotensin receptor blocker (ARB) categories. Of the 8105 patients registered in 2015, 31.0% cases developed new comorbidities in the following two-years. Totally, comorbidities were present in 46.9% patients in 2017. Age, body mass index, combined medication, history of stroke and kidney damage were independently related to uncontrolled BP.

Conclusions

Although the rate of treatment and control of hypertension were higher in Shanghai than average of country in a community population, the comorbidities accompanied by hypertension was still far from being satisfactory. Future efforts to promote GP and optimize management strategies are needed to improve the current status.

Introduction

Hypertension is one of the leading risk factors for premature death and disability around the world[1]. Unfortunately, blood pressure (BP) control is unsatisfactory worldwide especially in China, because those complex influence factors such as healthcare system, healthcare providers skills, patient adherence to therapy and so on. The latest nationwide survey indicated that the prevalence of hypertension in Chinese adults was 23.2% [2], however, the awareness rate, treatment rate and control rate of hypertension was

only 46.9%, 40.7% and 15.3%, respectively [2]. The Patient-Centered Evaluative Assessment of Cardiac Events (PEACE) Million Persons Project (MPP) study showed that the treatment rate was 22.9% and the BP control rate was only 5.7% among Chinese patients aged 35–75 years with hypertension [3]. It is clear that hypertension is a risk factor for atherothrombotic cardiovascular disease, stroke and kidney disease, etc. [1, 4–6]. Effectively manage and control BP levels will be beneficial for ultimately preventing the incidence of complications and target organ damage, as well as reducing the risk of death from these diseases [7, 8].

General practice (GP) originated in developed countries including Americas and European countries. It has great effects on the effective management of community chronic diseases, such as hypertension and diabetes, in elevating disease awareness and control rates, improving healthy lifestyle and preventing long-term complications [9]. As the largest city in China, Shanghai, the reform of health care has been started to implement since 2010 and fully rolled out in primary health care units [10], however, the effectiveness of GP-based hypertension management remains to be clarified.

This study was designed to estimate the drug treatment rate and BP control rate, further analyze the complication and comorbidity burden among patients with hypertension, aiming to comprehensively evaluate the management effectiveness of hypertension under GP administration in urban community of Shanghai.

Method

Study Design

A retrospective study among patients with hypertension managed by GP medical teams was performed to assess the annual effective management status from 2015 to 2017. Among the effective management populations, BP control rates and drug interventions were analyzed. Then the prevalence of hypertension complications and comorbidities in 2017 and their two-year cumulative incidence in 2016–2017 were estimated as well. In addition, patients were divided into BP control and uncontrolled groups to analyze the potential risk factors and comorbidities of hypertension. The study was approved by medical ethical review committee of Tongji University and informed consent was obtained for all participants.

Study Population

Data of patients were obtained from the Hospital Information System of Shiquan Street Community Health Service Center affiliated to Tongji University, Shanghai, China. Total 5 general medical teams were responsible for basic medical and public health services for around 140,000 inhabitants. Hypertensive patients who meet the diagnostic criteria of the Chinese Guidelines for the Prevention and Treatment of Hypertension 2010 were included in the study [11]. The administrative data contained information such as age, gender, body mass index (BMI), BP, follow-up time, medication and complications or comorbidities.

BP control standard: The BP control standard is that the BP of general hypertensive patients should be lower than 140/90 mmHg, and those with diabetes, kidney disease and coronary heart disease should be lower than 130/80 mmHg [12]. BP measurements were performed using a medical Omron HEM-7211 upper arm electronic sphygmomanometer, and the average of two BP measurements was recorded.

Effective management standard: According to the Chinese guidelines for the management of hypertension in the Community [13], patients with chronic diseases who are included in the community's general management should be followed up no less than 4 times a year. If the subject are followed up for ≥ 4 times a year, then classified as effective management.

Statistical analysis

Data cleaning and sorting and logical error detection of the original database were performed using SAS 9.4 (SAS Institute, Cary, NC). Measurement data were described using mean \pm standard deviation, and comparison between two groups and multiple groups were performed by *t* test and variance analysis, respectively. The count data was described using the composition ratio, and differences between groups were tested by Chi-square test. Two-year cumulative incidence rate in 2016–2017 was derived from the prevalence rate in 2017 minus the prevalence rate in 2015 only for patients registered from 2015. Logistic regression analysis was performed to determine factors independently associated with uncontrolled BP. All analyses were done with SPSS, version 20.0 (SPSS Inc., Chicago, IL, USA). Statistical significance was defined as a *P*-value ≤ 0.05 .

Results

The total number of registered hypertensive patients were 9692, 10247, 10964 respectively, and the effective management rates were 83.6%, 91.6%, 95.1% respectively from 2015 to 2017 (Fig. 1A). Overall, there was a gradual increasing tendency ($P < 0.001$) of the effective management rates within 3 years (Fig. 1B).

A total of 8105, 9384, and 10,431, respectively in 2015–2017 effectively managed hypertensive patients were included in the following analysis (Table 1). From 2015 to 2017, the proportion of women and patients > 60 years old increased, while their average systolic and diastolic blood pressure decreased. In 2017, men made up 43.9%, with an average age of 70 years and an average BP of 129/79 mmHg. Among the patients in effective management, drug treatment rates and BP control rates displayed a slightly growing trend ($P \leq 0.001$), reached 94.1% and 80.6% in 2017 respectively. Diabetes was the most common comorbidities, of which the prevalence reached about 32% in 2017. Then stroke, coronary heart disease and kidney damage occurred in 22.3%, 6.4% and 4.8% of patients respectively. Overall, the prevalence of almost all comorbidities constantly increased within 3 years and 4890 (46.9%) patients suffered from at least one comorbidity in 2017.

Table 1
Baseline of patients with hypertension in effective management

| Items | Years | | | P value |
|---|-----------------|-----------------|------------------|---------|
| | 2015 (N = 8105) | 2016 (N = 9384) | 2017 (N = 10431) | |
| Men (%) | 3753 (46.3) | 4129 (44.0) | 4576 (43.9) | 0.001 |
| Age (years) | 69.3 ± 10.4 | 69.3 ± 10.5 | 70.0 ± 10.4 | < 0.001 |
| Age ≥ 65 years (%) | 5066 (62.5) | 5837 (62.2) | 6823 (65.4) | < 0.001 |
| BMI (kg/m²) | 24.1 ± 3.1 | 24.0 ± 3.1 | 24.1 ± 3.1 | 0.067 |
| BMI ≥ 24 kg/m ² (%) | 3996 (49.3) | 4561 (48.6) | 5109 (49.0) | 0.652 |
| BP | | | | |
| Systolic BP (mmHg) | 130.5 ± 4.6 | 129.5 ± 4.1 | 128.6 ± 4.2 | < 0.001 |
| Diastolic BP (mmHg) | 80.0 ± 2.7 | 79.8 ± 2.4 | 78.7 ± 3.1 | < 0.001 |
| BP control rate (%) | 6321 (78.0) | 7496 (79.9) | 8421 (80.7) | < 0.001 |
| Drug intervention rate (%) | 7486 (92.4) | 8832 (94.1) | 9815 (94.1) | < 0.001 |
| CCB (%) | 4666 (57.6) | 5375 (57.3) | 5832 (55.9) | 0.046 |
| ARB (%) | 3159 (39.0) | 3752 (40.0) | 4547 (43.6) | < 0.001 |
| ACEI (%) | 864 (10.7) | 918 (9.8) | 789 (7.6) | < 0.001 |
| β-blocker (%) | 1067 (13.2) | 1222 (13.0) | 1195 (11.5) | < 0.001 |
| Diuretic (%) | 106 (1.3) | 127 (1.4) | 73 (0.7) | < 0.001 |
| Combined medication rate (%) | 2512 (31.0) | 2878 (30.7) | 3026 (29.0) | 0.006 |
| History of disease | | | | |
| Stroke (%) | 869 (10.7) | 1430 (15.2) | 2326 (22.3) | < 0.001 |
| Ischemic stroke (%) | 842 (10.4) | 1396 (14.9) | 2286 (21.9) | < 0.001 |
| Hemorrhage (%) | 50 (0.6) | 67 (0.7) | 96 (0.9) | 0.050 |
| Coronary heart disease (%) | 291 (3.6) | 615 (6.6) | 667 (6.4) | < 0.001 |
| Myocardial infarction (%) | 34 (0.4) | 47 (0.5) | 80 (0.8) | 0.004 |
| Angina pectoris (%) | 259 (3.2) | 579 (6.2) | 601 (5.8) | < 0.001 |
| Congestive heart failure (%) | 61 (0.8) | 92 (1.1) | 109 (1.0) | 0.107 |
| Note: BMI, Body mass index; BP, Blood pressure; CCB, Calcium Channel Blocker; ARB, Angiotensin Receptor Blocker; ACEI, Angiotensin Converting Enzyme Inhibitor. | | | | |

| Items | Years | | | P value |
|-------------------------|-----------------|-----------------|------------------|---------|
| | 2015 (N = 8105) | 2016 (N = 9384) | 2017 (N = 10431) | |
| Kidney damage (%) | 200 (2.5) | 328 (3.5) | 492 (4.7) | < 0.001 |
| Diabetes (%) | 1817 (22.4) | 2357 (25.1) | 3324 (31.9) | < 0.001 |
| Total comorbidities (%) | 2460 (30.4) | 3494 (37.2) | 4890 (46.9) | < 0.001 |

Note: BMI, Body mass index; BP, Blood pressure; CCB, Calcium Channel Blocker; ARB, Angiotensin Receptor Blocker; ACEI, Angiotensin Converting Enzyme Inhibitor.

The use of antihypertensive drugs was dominated by calcium channel blocker (CCB) and angiotensin receptor blocker (ARB) categories in 2015–2017, accounting for about half and a third for monotherapy patients, respectively (Fig. 2a). The proportion of combined medications was about 30%, of which CCB combined with ARB accounted for 48.1%-57.7% (Fig. 2b).

Figure 3 showed the cumulative incidence rate of comorbidities from 2015 to 2017. In hypertensive patients registered in 2015, 2514 (31.0%) cases developed new comorbidities in the following two-year. Among them, the highest incidence was attributed to stroke (15.2%), followed by diabetes (14.0%) and coronary heart disease (4.3%).

About 19.3% of hypertensive patients did not meet the BP control criteria in 2017 (Table 2). Compared with those with controlled BP, patients with uncontrolled BP were older and had a higher BMI, more combined medication as well as higher prevalence of comorbidities. After the multivariate logistic regression analysis, age, BMI, combined medication, history of stroke and kidney damage were independently associated with BP control (Fig. 4).

Table 2
Analysis of factors associated with blood pressure control

| Factors | Controlled (N = 8421) | Uncontrolled(N = 2010) | P Value |
|-----------------------------------|-----------------------|------------------------|---------|
| Men (%) | 3717 (44.1) | 859 (42.7) | 0.255 |
| Age ≥ 65 years (%) | 5401 (64.1) | 1422 (70.7) | < 0.001 |
| BMI ≥ 24 kg/m ² (%) | 4033 (47.9) | 1076 (53.5) | < 0.001 |
| Non-pharmacological treatment (%) | 229 (2.7) | 51 (2.5) | 0.650 |
| Drug intervention (%) | 7907 (93.9) | 1908 (94.9) | 0.079 |
| Combined medication (%) | 2309 (27.4) | 717 (35.7) | < 0.001 |
| History of stroke (%) | 1698 (20.2) | 628 (31.2) | < 0.001 |
| Coronary heart disease (%) | 496 (5.9) | 171 (8.5) | < 0.001 |
| Congestive heart failure (%) | 71 (0.8) | 38 (1.9) | < 0.001 |
| Kidney damage (%) | 229 (2.7) | 263 (13.1) | < 0.001 |

Discussion

A primary care database from 2015 to 2017 was analyzed to report the management effectiveness among hypertensive patients in this study. The results indicated that the effective management rates significantly rose from 83.6–95.1% within 3 years in urban community of Shanghai; Increase in drug treatment rates and BP control rates were observed among the effectively managed patients, whereas the two-year cumulative incidence of comorbidities indicated unpleasant results.

The current general status of hypertension management in China is poor because of the high prevalence and poor treatment and control effect. Through the PEACE MPP study, only 33.8% of the 3362 basic medical institutions nationwide stocks all four conventional classes of antihypertensive drugs [14], which indicates the alarming insufficient of medical resources. However, in the largest city of China like Shanghai, the treatment rate and BP control rate of hypertensive patients reached at 94.1% and 80.7% in 2017, respectively. This is mainly attributed to the effective management of GP, since it has great advantages in terms of health education, continuous supervision, follow-up, and timely adjustment of treatment prescription for hypertensive patients [15]. Another reason is that the community is located in urban region of Shanghai, the most developed cities in China. The superior medical conditions and the generally highly educated residents make it possible that the situation of hypertension management is better than the average level in other parts of the country.

These advantages of our results still exist when compared with recent survey data from other countries [16, 17]. A retrospective analysis showed that the BP control rate of hypertension was 60.6% in the general practice in Italy in 2013 [18]. In the most recent surveys on high-income countries, their treatment

rates were at most 80% and control rates were less than 70% [16]. Among them, Canada, the United States, South Korea and Germany have the highest control coverage, and they all have national hypertension education and health check-up, which is definitely important for management effect [16]. Overall, the treatment and control effects of hypertensive patients in this study were considerable.

At present, there are many types of antihypertensive agents available for patients, mainly including CCB, ARB, angiotensin converting enzyme inhibitor (ACEI), diuretics and beta blockers [5, 19]. The guidelines for prevention and treatment of hypertension in China recommended that all five major classes of antihypertensive drugs could be used as initial treatment drugs, and appropriate drugs for individual patient should be chosen according to the specific population and comorbidities [12]. Many studies pointed out that CCB drugs significantly decreased the incidence of stroke and mortality in patients with hypertension especially in eastern Asian population [20–22]. In the Avoiding Cardiovascular events through Combination therapy in Patients Living with Systolic Hypertension (ACCOMPLISH) study, CCB/ACEI combination reduced approximately 20% hazard ratio for cardiovascular events compared to diuretic/ACEI regardless of the presence of cardiovascular disease [23, 24]. In addition, ARB and ACEI are particularly suitable for patients with diabetes [7, 8, 12]. These evidences partly explain that CCB and ARB categories became the most favored antihypertensive agents since the prevalence of stroke and diabetes were relatively high in this population.

Although the treatment rate and control rate of hypertensive patients in this community seemed to be gratifying, the incidence rate of comorbidities was still unoptimistic. Up to 46.9% hypertensive patients had at least one comorbidity in 2017 and 31% of them experienced new comorbidities within two years. Through the Chinese National Surveillance System, the most common comorbidity of hypertension was coronary heart disease, with detection rates of 21.71%, while 7.53% had cerebral infarction which ranked fifth [25]. In contrast, the incidence of stroke (22.3%) was particularly high, while coronary heart disease (6.4%) was relatively lower in our study. Of note, the population was generally old with an average age of 70 years old, one of independent risk factors for the comorbidities, especially for stroke. On the other hand, recent study indicated that different comorbidities of hypertension influenced the patients' choices of hospital class to visit in China, that the patients with coronary heart disease were more likely to visit higher-classed hospitals instead of community hospitals [26]. Anyway, the high prevalence of comorbidities reminds general practitioners that it should not only aim to lower BP in the management of hypertension, but also focus on the prevention and treatment of other cardiovascular risk factors, such as using the lipid-lowering drugs and antithrombotic drugs.

BP control is associated with many factors such as age, lifestyle, BP level, choice of antihypertensive drugs, and compliance. And the resistant hypertension greatly increases cardiovascular risk. This study also indicated that uncontrolled hypertensive patients possessed higher cardiovascular risk than patients with target BP, since the history of stroke and kidney damage were more common after multivariate logistic regression analysis.

This study assessed the current status of patients with hypertension in general practice administration in Shanghai, China, including antihypertensive drug intervention rate, BP control rate, medication prescriptions and comorbidities. The research findings might provide useful insights into how to effectively improve management strategies and what might be the current burden of cardiovascular comorbidities associated with hypertension.

There are also some limitations in this study. Only one community was selected as a single-center study, which means selection bias existed, and we excluded hypertensive patients who were not effectively managed (less than 4 visits per year) in the analysis. Moreover, a retrospective study does not adequately analyze the causal relationship between BP control and comorbidities. In addition, we were unable to assess other risk factors such as smoke status and blood lipid level for comorbidities, therefore could not infer how many parts of these increased risks of comorbidities were related to hypertension.

Conclusions

The effective management of treatment and BP control for hypertensive patients in GP has been greatly improved in Shanghai compared to the national average situation in China. Nevertheless, the comorbidities accompanied by hypertension are still heavy. More efforts to implement and promote general practice are needed to improve the management of hypertension. Future research is also required to provide evidence of how to choose treatment strategies for hypertensive patients to achieve reduced comorbidities not just lower BP.

Abbreviations

| | |
|------|---|
| BP | Blood pressure |
| GP | General practice |
| BMI | Body mass index |
| CCB | Calcium channel blocker |
| ARB | Angiotensin receptor blocker |
| ACEI | Angiotensin converting enzyme inhibitor |

Declarations

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Ethical approval and consent to participate: The study was approved by medical ethical review committee of Tongji University and written informed consent was obtained for all participants.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Authors' contributions: XL and YH contributed to the study design and data analysis, as well as draft writing. YZ and LW performed the literature review and data analysis. JL and LZ contributed to the study design review and draft final revision. All authors read and approved the final manuscript.

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Figures

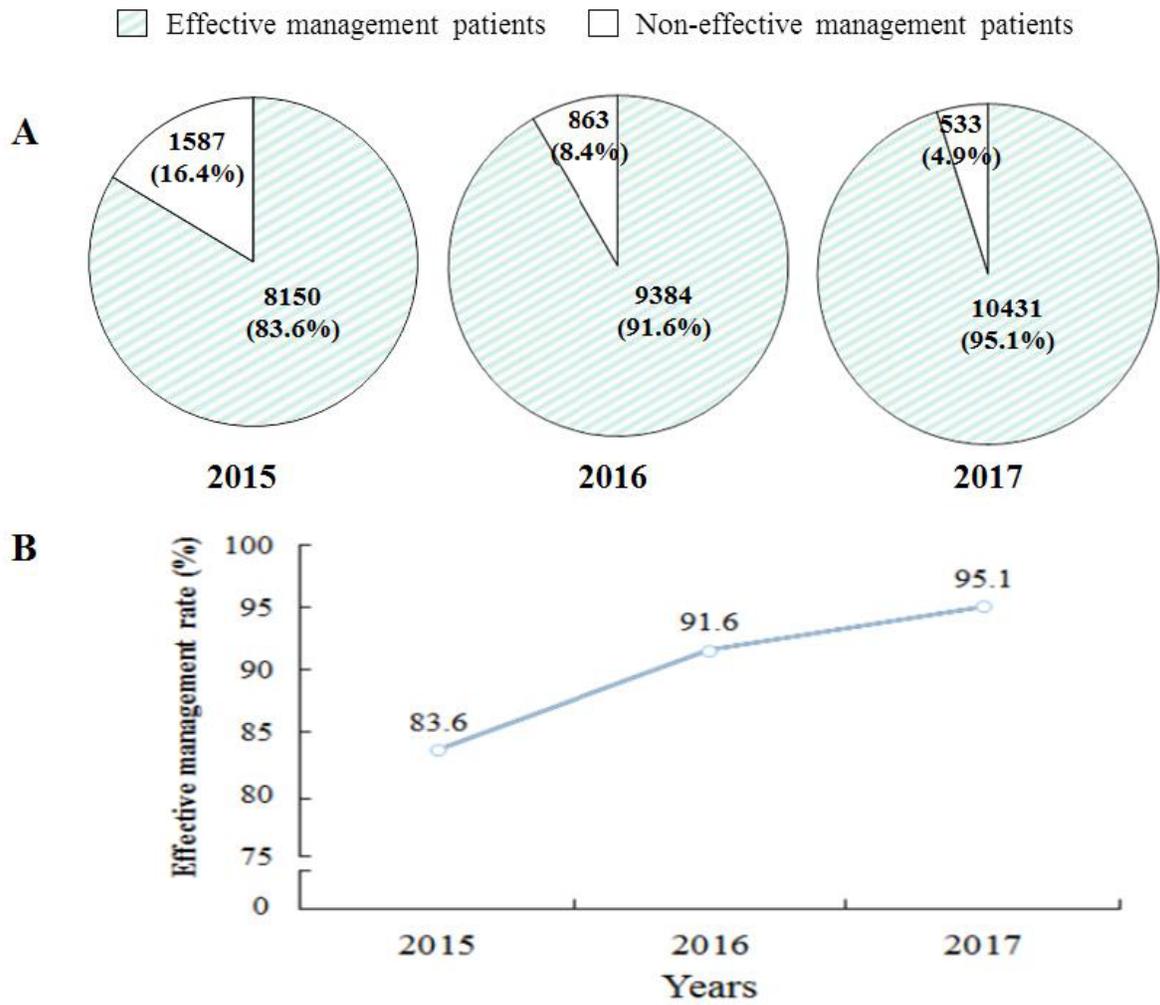


Figure 1

Effective management profile of patients with hypertension in 2015-2017

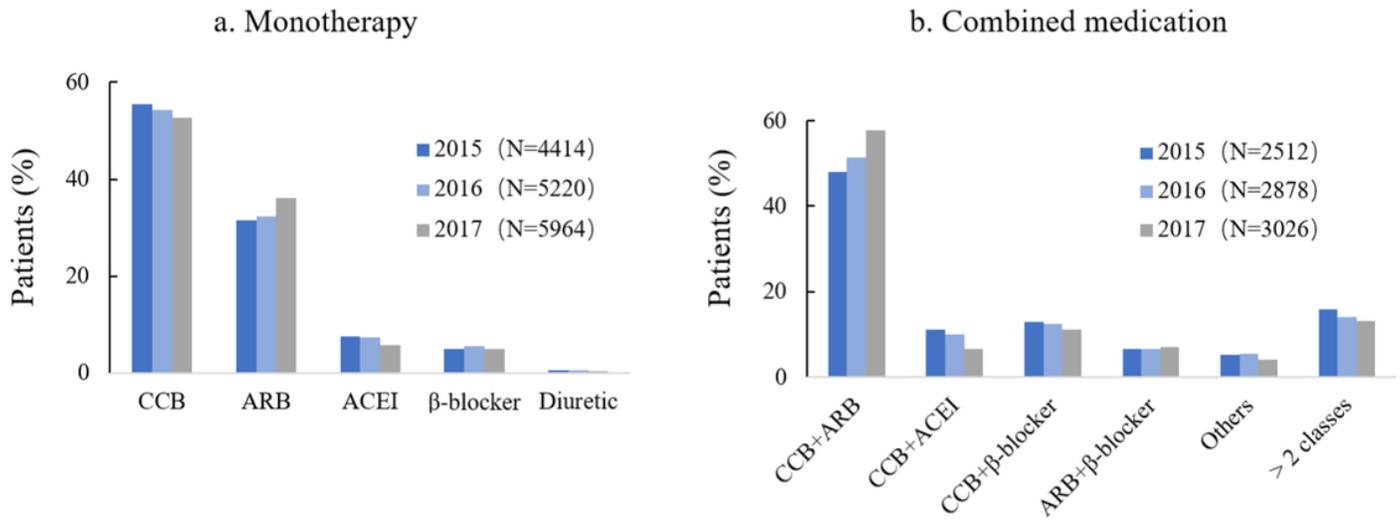


Figure 2

Class of antihypertensive drug in patients receiving monotherapy (a) or combined medication (b). Note: CCB, Calcium channel blocker; ARB, Angiotensin receptor blocker; ACEI, Angiotensin converting enzyme inhibitor.

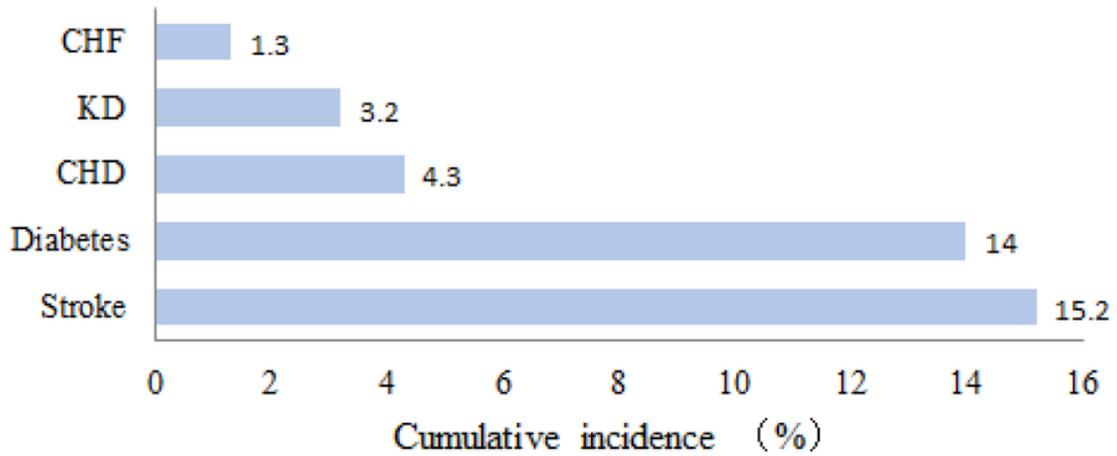


Figure 3

Two-year cumulative incidence of comorbidities in hypertensive patients. Note: CHD, Coronary heart disease; CHF, Congestive heart failure; KD, Kidney damage

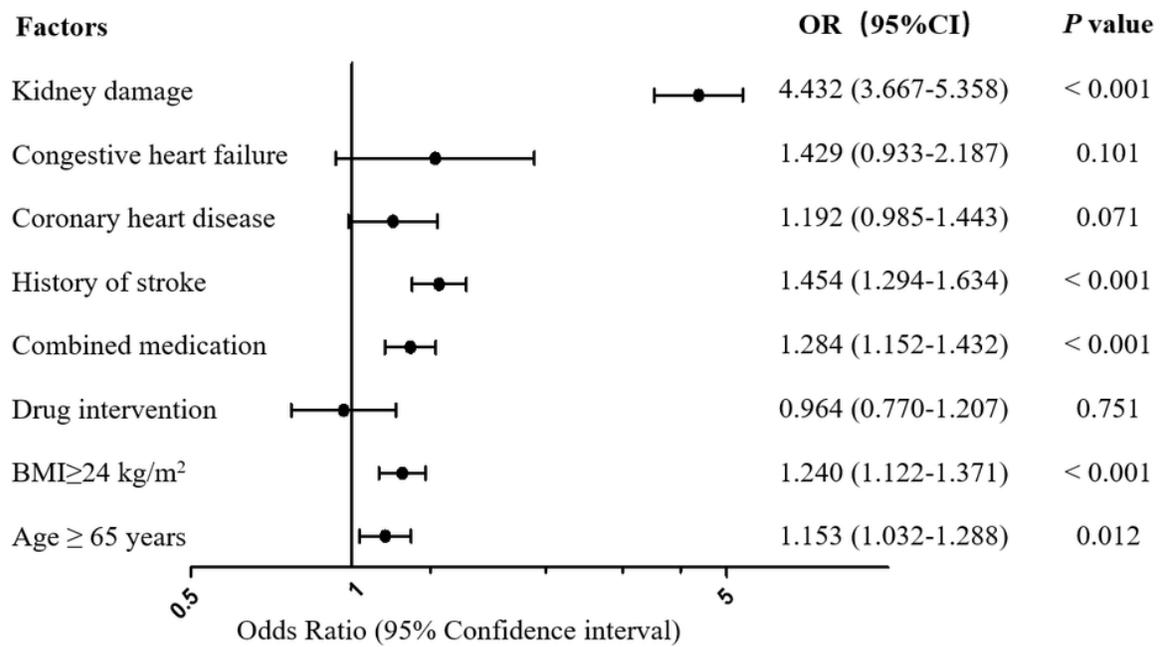


Figure 4

Multivariate logistic regression analysis of factors associated with uncontrolled blood pressure.