Prevalence, Awareness, Treatment, and Control of Hypertension in China

Dongfeng Gu, Kristi Reynolds, Xigui Wu, Jing Chen, Xiufang Duan, Paul Muntner, Guanyong Huang, Robert F. Reynolds, Shaoyong Su, Paul K. Whelton, Jiang He, for the InterASIA Collaborative Group

Abstract—The objective of this study was to estimate the prevalence and distribution of hypertension and to determine the status of hypertension awareness, treatment, and control in the general adult population in China. The International Collaborative Study of Cardiovascular Disease in ASIA (InterASIA), conducted in 2000–2001, used a multistage cluster sampling method to select a nationally representative sample. A total of 15 540 adults, age 35 to 74 years, were examined. Three blood pressure measurements were obtained by trained observers by use of a standardized mercury sphygmomanometer after a 5-minute sitting rest. Information on history of hypertension and use of antihypertensive medications was obtained by use of a standard questionnaire. Hypertension was defined as a mean systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg, and/or use of antihypertensive medications. Overall, 27.2% of the Chinese adult population age 35 to 74 years, representing 129 824 000 persons, had hypertension. The age-specific prevalence of hypertension was 17.4%, 28.2%, 40.7%, and 47.3% in men and 10.7%, 26.8%, 38.9%, and 50.2% in women age 35 to 44 years, 45 to 54 years, 55 to 64 years, and 65 to 74 years, respectively. Among hypertensive patients, only 44.7% were aware of their high blood pressure, 28.2% were taking antihypertensive medication, and 8.1% achieved blood pressure control (<140/90 mm Hg). Our results indicate that hypertension is highly prevalent in China. The percentages of those with hypertension who are aware, treated, and controlled are unacceptably low. These results underscore the urgent need to develop national strategies to improve prevention, detection, and treatment of hypertension in China. (Hypertension. 2002;40:920-927.)

Key Words: hypertension, detection and control ■ cross-sectional studies ■ population ■ China

Cardiovascular disease (CVD) is the leading cause of mortality worldwide and is estimated to account for ≈14.3 million deaths in 1990.1,2 The majority of those deaths (≈9.1 million) occurred in economically developing countries, and much of the burden of CVD in developing countries occurs in China.1,2 The morbidity and mortality of CVD in China is projected to increase, both in absolute terms and as a proportion of total disease burden, over the next 20 years.3 The emergence of CVD as a leading cause of death in China, in large part, is a result of the rapid economic growth and associated sociodemographic change that has occurred over the past few decades. Over this period, although the burden of infectious disease has fallen, changes in lifestyle and diet and an increase in life expectancy have resulted in a greatly increased burden of CVD and other chronic diseases.4–6

Hypertension is one of the most important modifiable risk factors for CVD and renal disease in Western7–9 and Asian10,11 populations. According to previous national surveys conducted in China, the prevalence and absolute numbers of hypertension have increased dramatically during the past several decades.12,13 For example, the estimated number of hypertension cases among Chinese adults has increased from 30 million in 1960 to 59 million in 1980 and to 94 million in 1990.13 However, the previous national surveys did not employ random sampling methods for selection of study participants or standardized methods for measurement of blood pressure (BP).

Periodic national surveys are important to provide essential information necessary for planning hypertension prevention and control programs. The International Collaborative Study of Cardiovascular Disease in ASIA (InterASIA) study was designed to provide current and reliable data on the prevalence of hypertension and for estimates of awareness, treatment, and control of hypertension in the adult population in China.

Methods

Sample Design

InterASIA used a 4-stage stratified sampling method to select a nationally representative sample of the general population age 35 to
Control of hypertension was defined as pharmacological treatment of medication for management of high BP at the time of the interview. 15 Awareness of hypertension was defined as self-reported current treatment for hypertension with antihypertensive medication. 15

Hypertension was defined as an average systolic BP (SBP) ≥140 mm Hg and/or an average diastolic BP (DBP) ≥90 mm Hg, and/or taking antihypertensive medication. 90 mm Hg and/or taking antihypertensive medication.

The prevalence and mean levels were weighted to represent the total Chinese adult population age 35 to 74 years. The weights were calculated based on the 2000 China population census data and InterASIA sampling scheme and took into account several features of the survey, including oversampling for specific age or geographic subgroups, nonresponse, and other demographic or geographic differences between the sample and the total population. Standard errors were calculated by a technique appropriate to the complex survey design. All data analyses were conducted using STATA 7.0 (Statistics/Data Analysis) software.

### Results

#### Prevalence

Overall, 27.2% of the Chinese adult population age 35 to 74 years, representing 129 824 000 persons, had hypertension (Table 1). The overall prevalence of hypertension was slightly higher among men than among women. The prevalence of hypertension increased with age in both men and women. For every age group up to 64 years, men had a higher age-specific rate of hypertension than that of women. However, the reverse was true for ≥65 years of age (Figure 1).

#### Mean BP Levels

Table 2 presents gender- and age-specific mean BP values for the total sample and for 3 subgroups defined by hypertension status. Overall, the average SBP and DBP for normotensive subjects were 32.4 and 14.0 mm Hg lower than the corresponding values for those with treated hypertension, and 33.0 and 15.8 mm Hg lower than the corresponding values for those with untreated hypertension. In contrast, the overall SBP and DBP differences between treated and untreated participants with hypertension were only 0.6 and 1.8 mm Hg.

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**Table 1. Prevalence of Hypertension* in Adult Population, Aged 35 to 74 Years, in China, 2000–2001**

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Men</th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td></td>
<td>Estimated Population 1</td>
<td></td>
<td>Percent</td>
<td></td>
<td>Estimated Population 1</td>
<td></td>
<td>Percent</td>
</tr>
<tr>
<td>Total</td>
<td>28.6 (0.7)</td>
<td>69 973 (1858)</td>
<td>25.8 (0.7)</td>
<td>59 850 (1671)</td>
<td>27.2 (0.5)</td>
<td>129 824 (2278)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>17.4 (0.9)</td>
<td>16 500 (945)</td>
<td>10.7 (0.7)</td>
<td>9548 (673)</td>
<td>14.1 (0.6)</td>
<td>26 048 (1142)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>28.2 (1.3)</td>
<td>21 053 (1124)</td>
<td>26.8 (1.3)</td>
<td>18 785 (1018)</td>
<td>27.5 (0.9)</td>
<td>39 838 (1483)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55–64</td>
<td>40.7 (1.6)</td>
<td>18 295 (938)</td>
<td>36.9 (1.6)</td>
<td>16 269 (846)</td>
<td>39.8 (1.2)</td>
<td>34 563 (1236)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>47.3 (2.3)</td>
<td>14 126 (937)</td>
<td>50.2 (2.3)</td>
<td>15 248 (958)</td>
<td>48.8 (1.6)</td>
<td>29 374 (1320)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are % (SE) or n(SE).

*SBP ≥140 mm Hg and/or DBP ≥90 mm Hg and/or taking antihypertensive medication.

1 In thousands.
respectively. Overall, men had slightly higher SBP and DBP levels than those of women. Mean SBP increased with age throughout entire age range, whereas DBP increased with age until 65 years.

**Distribution of BP**

Gender- and age-specific estimates of the distribution of BP according to the classification system recommended by the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure are presented in Table 3. Overall, 56.8% of men and 63.4% of women had optimal or normal BP (SBP < 130 mm Hg and DBP < 85 mm Hg), whereas 16.4% of men and 13.5% of women had high normal BP. The prevalence of stage 1, 2, and 3 hypertension was 18.1%, 5.6%, and 3.2% in men and 15.0%, 5.7%, and 2.4% in women, respectively.

**Awareness, Treatment, and Control of Hypertension**

Table 4 provides the percentages of participants with hypertension who were aware of their hypertensive status, who were being treated with antihypertensive medications, who had their hypertension controlled, and who were both treated and controlled. Overall, 44.7% of those with hypertension were aware of their diagnosis, only 28.2% were taking prescribed medication to lower their BP, and only 8.1% achieved BP control. When confined to those hypertensives who were being treated, only 28.8% were being controlled. More women (50.8%) were aware of their hypertension than were men (39.5%). Treatment and control were also more common among women than among men. Among women, awareness was most common in the 45- to 64-year age group, whereas among men, the 65- to 74-year age group was most aware of their hypertension. Less than one fourth (23.5%) of men reported that they were taking antihypertensive medication for their high BP, and the percentage was much lower for men age 35 to 44 years (13.7%). Only 33.8% of women reported that they were being treated for their hypertension. Only 6.1% of men and 10.5% of women with hypertension achieved BP control, and the percentages were even lower for both men and women age 35 to 44 years (3.9% and 8.3%, respectively).

**Nonpharmacological Interventions**

Participants who reported a prior diagnosis of hypertension by a health care provider were asked about the use of the following nonpharmacological lifestyle modifications for

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**TABLE 2. SBP and DBP in Adult Population, Aged 35 to 74 Years, by Hypertension Status and Age in China, 2000–2001**

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Normotensive</th>
<th>Treated Hypertensive</th>
<th>Untreated Hypertensive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBP</td>
<td>DBP</td>
<td>SBP</td>
<td>DBP</td>
</tr>
<tr>
<td>Total</td>
<td>116.3 (0.1)</td>
<td>74.9 (0.1)</td>
<td>148.7 (0.9)</td>
<td>88.9 (0.5)</td>
</tr>
<tr>
<td>35–44</td>
<td>114.3 (0.2)</td>
<td>74.7 (0.1)</td>
<td>140.5 (1.7)</td>
<td>92.3 (1.2)</td>
</tr>
<tr>
<td>45–54</td>
<td>116.4 (0.3)</td>
<td>75.7 (0.2)</td>
<td>147.2 (1.6)</td>
<td>92.3 (0.9)</td>
</tr>
<tr>
<td>55–64</td>
<td>119.4 (0.3)</td>
<td>74.8 (0.2)</td>
<td>150.4 (1.6)</td>
<td>87.9 (1.0)</td>
</tr>
<tr>
<td>65–74</td>
<td>120.9 (0.5)</td>
<td>72.7 (0.4)</td>
<td>152.4 (1.8)</td>
<td>83.9 (0.9)</td>
</tr>
<tr>
<td>Men</td>
<td>117.5 (0.2)</td>
<td>76.0 (0.1)</td>
<td>148.3 (1.4)</td>
<td>90.9 (0.8)</td>
</tr>
<tr>
<td>35–44</td>
<td>116.5 (0.3)</td>
<td>76.2 (0.2)</td>
<td>139.2 (2.0)</td>
<td>94.5 (1.6)</td>
</tr>
<tr>
<td>45–54</td>
<td>116.8 (0.4)</td>
<td>76.6 (0.3)</td>
<td>145.6 (2.4)</td>
<td>95.1 (1.4)</td>
</tr>
<tr>
<td>55–64</td>
<td>120.0 (0.5)</td>
<td>75.3 (0.3)</td>
<td>150.8 (2.7)</td>
<td>90.6 (1.6)</td>
</tr>
<tr>
<td>65–74</td>
<td>120.7 (0.7)</td>
<td>73.6 (0.5)</td>
<td>153.5 (2.7)</td>
<td>84.5 (1.3)</td>
</tr>
<tr>
<td>Women</td>
<td>115.1 (0.2)</td>
<td>73.8 (0.1)</td>
<td>149.0 (1.1)</td>
<td>87.2 (0.6)</td>
</tr>
<tr>
<td>35–44</td>
<td>112.2 (0.3)</td>
<td>73.3 (0.2)</td>
<td>142.0 (2.7)</td>
<td>90.0 (1.7)</td>
</tr>
<tr>
<td>45–54</td>
<td>115.9 (0.4)</td>
<td>74.8 (0.2)</td>
<td>148.4 (2.1)</td>
<td>90.4 (1.1)</td>
</tr>
<tr>
<td>55–64</td>
<td>118.9 (0.5)</td>
<td>74.2 (0.3)</td>
<td>150.0 (1.9)</td>
<td>85.8 (1.1)</td>
</tr>
<tr>
<td>65–74</td>
<td>121.1 (0.7)</td>
<td>71.8 (0.6)</td>
<td>151.6 (2.3)</td>
<td>83.4 (1.2)</td>
</tr>
</tbody>
</table>

Values are mean (SE).
treatment of hypertension: weight control or weight loss, reduction in salt or sodium intake, increase in exercise, restriction of alcohol intake, and use of potassium pills or foods high in potassium. Table 5 presents results on nonpharmacological therapies reported being told to use nonpharmacological therapies for hypertension. Overall, 55.5% of those with an average BP \(\geq 140/90\) mm Hg were prescribed more, and were in current use more, for participants with an average BP \(\geq 140/90\) mm Hg than for those with an average BP \(<140/90\) mm Hg (57.9% versus 50.1% for ever prescribed; 47.2% versus 41.5% for current use).

More men (64.4%) than women (47.4%) reported being told to use \(\geq 1\) of the nonpharmacological therapies for treatment of hypertension. Current use of \(\geq 1\) of the therapies also was more common among men (51.5%) than among women (39.9%). Among men, alcohol reduction was the most commonly reported therapy (41.9%), whereas sodium reduction was the most commonly reported therapy among women (32.8%).

### TABLE 4. Percentage of Persons With Hypertension Who Are Aware, Treated, and Controlled and Percentage of Treated Persons with Hypertension Who Are Controlled in Adult Population, Aged 35 to 74 Years, in China, 2000–2001

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Hypertensives</th>
<th>Controlled Treated Hypertensives</th>
<th>Women</th>
<th>Hypertensives</th>
<th>Controlled Treated Hypertensives</th>
<th>Total</th>
<th>Hypertensives</th>
<th>Controlled Treated Hypertensives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aware % (SE)</td>
<td>Treated % (SE)</td>
<td></td>
<td>Aware % (SE)</td>
<td>Treated % (SE)</td>
<td></td>
<td>Aware % (SE)</td>
<td>Treated % (SE)</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>34.9 (2.8)</td>
<td>13.7 (2.0)</td>
<td>3.9 (1.1)</td>
<td>28.5 (6.9)</td>
<td>37.7 (3.4)</td>
<td>21.4 (2.9)</td>
<td>8.3 (2.0)</td>
<td>38.7 (7.6)</td>
</tr>
<tr>
<td>45–54</td>
<td>38.2 (2.6)</td>
<td>23.5 (2.2)</td>
<td>5.9 (1.3)</td>
<td>24.9 (4.9)</td>
<td>55.6 (2.8)</td>
<td>37.6 (2.6)</td>
<td>11.7 (1.7)</td>
<td>31.0 (4.0)</td>
</tr>
<tr>
<td>55–64</td>
<td>41.8 (2.5)</td>
<td>27.0 (2.3)</td>
<td>7.3 (1.3)</td>
<td>26.9 (4.4)</td>
<td>55.8 (2.6)</td>
<td>37.0 (2.5)</td>
<td>10.5 (1.7)</td>
<td>28.4 (1.1)</td>
</tr>
<tr>
<td>65–74</td>
<td>43.8 (3.3)</td>
<td>30.4 (3.1)</td>
<td>7.7 (1.7)</td>
<td>25.3 (5.1)</td>
<td>48.0 (3.1)</td>
<td>33.2 (3.0)</td>
<td>10.3 (1.9)</td>
<td>31.0 (5.1)</td>
</tr>
</tbody>
</table>

Values are % (SE).

*This is the proportion of hypertensives with SBP <140 mm Hg and DBP <90 mm Hg.

†This is the proportion of hypertensives on an antihypertensive medication with systolic BP <140 mm Hg and diastolic BP <90 mm Hg.
Participants who reported a prior diagnosis of hypertension by a health care provider also were asked about the use of complementary or alternative treatments for hypertension. Examples of complementary or alternative treatments include traditional Chinese medicine and herbs. Overall, 14% (11.6% of men and 16.6% of women) of those with a history of hypertension reported ever using complementary or alternative treatments for their hypertension. Percentage of use was higher among those with an average BP of 140/90 mm Hg and current use of lifestyle modification or complementary or alternative treatments for their hypertension. Of the participants who were not classified as having hypertension, 2.3% reported having been told by a physician or other health care professional that they had high BP, and only 8.1% were taking antihypertensive medication and had a BP of 140/90 mm Hg lower their BP, and only 8.1% were taking prescribed medication to lower their BP, and only 8.1% were taking antihypertensive medication and had a BP of 140/90 mm Hg. Inclusion of those participants who had an average BP of 140/90 mm Hg but reported both a history of hypertension and current use of lifestyle modification or complementary or alternative treatments to lower their BP would result in an estimated 133 million hypertensive Chinese adults. If the current definition of hypertension were changed to include those told they were hypertensive on 2 occasions, 138 million Chinese adults age 35 to 74 years would have hypertension.

**Discussion**

InterASIA represents the most reliable and up-to-date information on the current prevalence of hypertension and the extent to which it is being treated and controlled in the adult population in China. This study was conducted in a large representative sample of the Chinese adult population using standard protocols and instruments. Strict training processes for data collectors and vigorous quality assurance programs were employed to ensure the quality of the data collection. Additional strengths of the study include a high response rate, 3 BP measurements, and detailed information on history of hypertension and on pharmaceutical and lifestyle treatment. For all these reasons, InterASIA data probably provide the most accurate and precise estimates of hypertension detection, treatment, and control to date in the general Chinese population.

Overall, InterASIA results indicate that 27.2%, or 130 million, adults age 35 to 74 years in China have hypertension. Only 44.7% of those with hypertension were aware of their diagnosis, only 28.2% were taking prescribed medication to lower their BP, and only 8.1% were taking antihypertensive medication and had a BP of 140/90 mm Hg. Of the pharmacologically treated hypertensives, only 28.8% had a BP of 140/90 mm Hg. These findings indicate that hypertension has become a major public health problem in China and underscore the urgent need to develop national strategies for prevention and treatment of hypertension in China.

Three national surveys of hypertension have been conducted in China over the past few decades. Because of the extent to which the selection of the sample and the measurement protocol influence prevalence estimation, caution...
should be observed in comparisons of the findings presented here to corresponding data from the previous surveys. With this in mind, the 1991 Chinese National Hypertension Survey may provide the most valid comparison with the present study regarding BP measurement methods and definition of hypertension. These data indicate that the prevalence of hypertension has increased from 20.2% to 28.6% (42% increase) in men and from 19.1% to 25.8% (35% increase) in women, respectively, during the past decade (Figure 1). More troublesome, the trend of increase in prevalence was much greater in younger age groups compared with older age groups. For example, the percentage increase was 74% in men and 62% in women age 35 to 44 years and 18% in men and 15% in women age 65 to 74 years. Without an effective intervention program, an epidemic of CVD and renal disease in China is inevitable in the near future.

The prevalence of hypertension in China estimated in the present study exceeds that of many developing countries and is similar to that in industrial counties. The overall prevalence of hypertension in Korea was estimated to be 19.8% in 1990. The 1993–1996 hypertension survey conducted in Taiwan indicated that the prevalence of hypertension was 26.0% in men and 19.0% in women. The age-specific prevalence of hypertension in our study was similar to that reported in the US population for those age 35 to 44 years and 45 to 54 years, but lower for those age ≥55 years (Figure 2). Similar to our findings, several national surveys have suggested a high prevalence of hypertension in developing countries. The Egyptian National Hypertension Project in 1991–1993 reported an even higher prevalence of hypertension than did the present study (Figure 2). Economic development, changes in lifestyle and diet, and an increase in life expectancy may explain the rapid increase in the prevalence and absolute number of hypertension in developing countries.

The percentage of awareness, treatment, and control of hypertension is unacceptably low in the Chinese adult population, as indicated from InterASIA data. Even more problematic, the mean BP level is similar in treated and untreated patients with hypertension. For example, the mean SBP was 148.7 and 149.3 mm Hg and DBP was 88.9 and 90.7 mm Hg in treated and untreated patients with hypertension, respectively, in the present study. In the US population, the average SBP and DBP differences between treated and untreated participants with hypertension were 9 and 5 mm Hg, respectively. A national high-BP education program should be established in China to promote community- and clinic-based BP screening. Physicians must regularly check their patients’ BP, and a more aggressive BP-lowering goal and strategy must be utilized.

Over 45% of the participants in InterASIA in China were currently using nonpharmacological therapies for treatment of hypertension. The use of such therapies is likely to increase given the emphasis placed on lifestyle modification in the management of hypertension. Therefore, the classifi-

### Table 6. Prevalence of Hypertension in Adult Population, Aged 35 to 74 Years, by Treatment Status and Percentage of the Normotensive Population Reporting a History of Hypertension in China, 2000–2001

<table>
<thead>
<tr>
<th></th>
<th>Percentage of Population</th>
<th>Estimated Population*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertensive¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No medicine prescribed</td>
<td>28.6 (0.7)</td>
<td>69 973 (1858)</td>
</tr>
<tr>
<td>Prescribed medicine</td>
<td>21.9 (0.6)</td>
<td>53 539 (1672)</td>
</tr>
<tr>
<td>Controlled</td>
<td>16.4 (0.4)</td>
<td>16 434 (938)</td>
</tr>
<tr>
<td>Not controlled</td>
<td>6.7 (0.2)</td>
<td>4288 (485)</td>
</tr>
<tr>
<td>Hypertensive¹</td>
<td>25.8 (0.7)</td>
<td>59 850 (1671)</td>
</tr>
<tr>
<td>No medicine prescribed</td>
<td>17.1 (0.6)</td>
<td>39 648 (1413)</td>
</tr>
<tr>
<td>Prescribed medicine</td>
<td>8.7 (0.4)</td>
<td>20 202 (989)</td>
</tr>
<tr>
<td>Controlled</td>
<td>2.7 (0.2)</td>
<td>6263 (571)</td>
</tr>
<tr>
<td>Not controlled</td>
<td>6.0 (0.4)</td>
<td>13 940 (827)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are % (SE) or n (SE).

¹Hypertension is defined as mean SBP ≥140 mm Hg and/or DBP ≥90 mm Hg at the survey examination and/or current treatment with a prescription antihypertensive medication.

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**Figure 2.** Prevalence of hypertension among 3 populations, ages 35 to 74 years: InterASIA (2000–2001), the Egyptian National Hypertension Project (1991–1993), and the Third National Health and Nutrition Examination Survey (1988–1994).
cation of hypertension should include the use nonpharmacological therapies. Inclusion of participants with a prior diagnosis of hypertension and current use of a nonpharmacological therapy or complementary or alternative treatment would have resulted in a prevalence estimate of 27.9%, or 133 million, hypertensive adults in China.

Perspectives

Compared with data from previous national surveys, the present study indicates that the prevalence of hypertension in China has increased dramatically during the past decade. More worrisome, the percentage of those with hypertension who are aware, treated, and controlled is unacceptably low. Our results underscore the urgent need to develop national strategies aimed at improving the prevention, detection, and treatment of hypertension in China in an effort to avert a CVD epidemic.

Appendix

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