How willing are the public to pay for anti-hypertensive drugs for primary prevention of cardiovascular disease: a survey in a Chinese city

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Background

Current recommendations on drug treatment of hypertension for primary prevention of cardiovascular disease are primarily determined by the evidence of effectiveness, disregard the resources available and values of people, and recommend a universally fixed risk cutoff for initiating drug treatment. The guidelines may have over-estimated the willingness of the public to accept and pay for these drugs and a fixed cutoff may not fit all populations. Moreover, the public may have been misinformed and are unable to make the right decision even if they are consulted. We conducted this study to address these issues and to describe the gap between current policy and what the public truly want.

Methods

A cross-sectional survey with face-to-face interviews of rural and urban residents in northern China. Before providing any information, we asked the residents whether they would accept drug treatment if they had hypertension and also asked them to estimate the 5-year cardiovascular risk in untreated hypertension and the benefits from anti-hypertensive drugs. We then informed the participants of necessary information and asked them above what benefit they would be willing to pay the current cost, and how much they would be willing to pay for the actual benefit, for anti-hypertensive drugs out of pocket.

Results

Eight hundred and eighty-seven rural residents and 921 urban residents were interviewed with a response rate of 97%. Ninety-five percent [95% confidence interval (CI) 94–96%] of the residents said they would take anti-hypertensive drugs if they had hypertension, although 91% (95% CI 89–92%) said they did not have sufficient knowledge to make a decision. Seventy-eight percent (95% CI 76–80%) believed that anti-hypertensive drugs were primarily to lower blood pressure or relieve symptoms. They over-estimated the cardiovascular risk of untreated

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hypertension by approximately 12 times and the absolute benefit of drug treatment by 20 times. Given the actual absolute benefit of the drugs, only 23% (95% CI 21–25%) were willing to pay the current annual cost of $500 Ren Min Bi (US$73.3, €54.8 as of 8 May 2009) for these drugs. Given the current cost, they were, on average, willing to pay for the drugs only when the 5-year cardiovascular disease risk was as high as 35% (95% CI 31–38%) or even higher.

**Conclusion**

The public in China are significantly misinformed and considerably over estimate the risk of hypertension and the benefit of treatment. The public’s willingness to pay for anti-hypertensive drugs is much lower than the current guidelines implicitly assume. The willingness to pay should be considered, along with other factors, when prescribing anti-hypertensive drugs to an individual patient or making hypertension guidelines for a population.

**Keywords**

Willingness to pay, hypertension, China, evidence-based policy, cardiovascular disease

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**Introduction**

China has a population of 1.3 billion and currently spends some 5–6% of its annual gross domestic product in health care. Medical services are relatively expensive; the average cost of a single hospital admission is about the same as China’s annual income per head. Government insurance schemes cover only a fraction of care. Outpatient services are inadequately insured in many parts of China and inpatient services, where covered, still leave patients with significant costs to bear. The rural cooperative medical scheme, for instance, reimburses only ~30% of inpatient expenditure. The proportion of the out-of-pocket payment in the total health care expenditure was 49% in 2006.

Cardiovascular disease (CVD) has become a major health burden to the country. Who and how many should be given anti-hypertensive and cholesterol-lowering drugs for primary prevention of CVD? This is probably one of the most important questions policy makers worldwide have to face these days. In China, 160 million people have hypertension and another 160 million have dyslipidemia, in addition to 9 million who have already had myocardial infarction or stroke.

At the national level, the annual cost of anti-hypertensive drugs is about one-seventh of the annual income of a rural family, and the cholesterol lowering drugs are much more expensive. By using the cheapest drugs [$1 Ren Min Bi (RMB) a day for anti-hypertensive and $2 RMB a day for cholesterol lowering drugs] (US$1 = 6.8 RMB, Euro$1 = 9.1 RMB as of 8 May 2009) available the annual drug costs alone could easily consume a third of the total healthcare expenditure of the country. Obviously, not all these people can be treated with drugs.

Furthermore, in a populous country like China, a small change in policy could affect millions of people and involve billions of dollars. For example, lowering the diastolic blood pressure cutoff for drug treatment by as small as a few mmHg could put tens of millions more people on drugs and incur a considerable extra cost to the healthcare system and individuals. Not only the evidence of effectiveness but also the resources and values should be carefully considered in making such important decisions.

Research has shown that hypertension is only one of the many risk factors for major cardiovascular complications. Anti-hypertensive drugs can, on average, prevent one major CVD event in some 30–50 people treated and the size of benefit for different people is determined more by a person’s overall CVD risk than by his blood pressure alone. Current guidelines have thus widely adopted the overall risk approach to primary prevention in which priority of anti-hypertensive drugs is given to high-risk people rather than people with just hypertension unless blood pressure is extremely high.

A crucial question that has yet to be answered is ‘Above what CVD risk should drugs be given?’ A change in the cutoff will change, importantly, the number of people who need to be treated with drugs and the amount of resources needed. The answer to this question will be largely determined by the resources made available for the intervention, which will in turn be determined by the wealth, needs and values of the society. The UK and WHO/ISH guidelines imply that a quarter of adults in western populations should receive
anti-hypertensive drugs.\textsuperscript{13} The Chinese hypertension guidelines largely adopted similar recommendations.\textsuperscript{14} Rarely have these recommendations addressed the issue of resources and values and even less is known on how they did it.\textsuperscript{2}

Whose voices should be listened to in making such decisions? David Eddy argued that the public must be consulted as they are the eventual payer or bearer of the costs in any healthcare system.\textsuperscript{15} It is also the public (consisting of current and future patients) that are going to take the drugs and live with the consequences. The recommendation, in particular for individuals who pay for the treatment directly from their own pocket, must consider how the individual thinks.

Unfortunately, the public seem rarely to be consulted about the choice made in the national recommendations. Even if consulted, they may be poorly informed and unable to make the right decision. To the contrary, parties with different interests seem to have been largely influencing the making of these decisions.\textsuperscript{16,17} The CVD risk of hypertension and benefit of treatment may be widely misperceived and significantly over-rated in the public. The problem would be particularly severe and relevant in developing countries where the public are less educated and fewer resources are available.

No matter what the providers believe, what has been recommended, and what efforts have been made, the fact that hypertension is poorly controlled worldwide.\textsuperscript{18} In China, only 5% of hypertensives have their blood pressure under control.\textsuperscript{19} This strongly suggests a need to review the current policies. With this in mind, we conducted a survey in China to see whether the public has the knowledge for making an informed choice, to assess how willing the public are to pay for anti-hypertensive drugs and to show how large the departure of the current policy and practice is from what the public truly want. The public’s willingness to pay will provide important information for defining an acceptable and affordable risk cutoff for drug treatment.

Methods

Study population

A cross-sectional survey was carried out between May and November 2005 in Baotou City of Inner Mongolia Autonomous Region. Baotou is an important industrial base in northern China. The city has a population of 2.3 million with 1.4 million living in urban areas and 0.9 million in rural areas. It has the country’s average household income,\textsuperscript{20} an important determinant of people’s willingness to pay for medical interventions. The illiteracy rate in the city is 9.1%, similar to the country’s average of 11.0%.\textsuperscript{21} The number of healthcare workers in the city is 5.8 per 1000 residents, higher than the country’s average of 3.4 per 1000 residents.\textsuperscript{22} In 2005, some 50–60% of urban and rural residents in the surveyed areas had some partial medical insurance.

Study subjects were drawn from a rural village with 1569 households and 5632 family members in a remote suburb of Baotou and an urban district of the city with 1698 households and 5131 family members. The city, and the urban and rural areas in it were not selected at random but subjectively determined to represent the average economic, educational and medical status of the country, and of the city. Eligible subjects were defined as those who were aged 35–75 years, free of doctor-diagnosed stroke or myocardial infarction, and able to understand and answer the questions. As household income may affect the willingness to pay for individuals in it, by including only one family member from each household, more households can be represented in the survey given the same sample size. If there were two or more eligible persons in a household, we interviewed the one whose birth date occurred earliest in the year. Nine hundred and ninety-six households in the urban area and 988 households in the rural area had at least one family member aged 35–74 years and were visited.

Questionnaire

A face-to-face interview was used with a questionnaire particularly designed for this study. The preliminary questionnaire was evaluated and revised twice for its contents and validity by a group of senior specialists from Peking University and the Chinese University of Hong Kong, including two cardiologists, one health economist, two epidemiologists, one public health physician, one pharmacist, and two patient representatives. The revised questionnaire was then tested in patients in the Department of Internal Medicine of Peking University Shenzhen Hospital, which resulted in considerable improvements in the format, flow of questions and clarity of presentation. After consultations with five local interviewers and over 20 potential interviewees, the language was then adapted to the local dialect. The finalized questionnaire had two versions: one for urban residents and one for rural residents. They contained exactly the same set of questions but differed in the dialect used.

The questionnaire included demographic information, household income, cardiovascular risk factors, self-perceived CVD risk in hypertension, knowledge on hypertension and drug treatment and willingness to pay for anti-hypertensive drugs.

Regarding the willingness to pay, the main part of the survey, we assumed that everyone had hypertension and would have to pay from their own pocket. Before providing the residents any relevant information, we asked them whether they would like to take up anti-hypertensive drugs if they had hypertension. After that, we explained to them at length, with
examples and in their own dialect, that one should carefully consider resources available, opportunity costs and benefits, risks and costs of different treatment options when making decisions regarding paying for medical interventions. We then provided information on the benefits in three different ways (Box 1) and each time we assessed again their willingness to pay for anti-hypertensive drugs.

First, we described hypertension and its treatment generally, and provided no quantitative information (see Box 1 for details). We then further described the drug benefit quantitatively by using the relative risk reduction (RRR) and number needed to treat (NNT). The RRR does not take into account the baseline risk and tends to exaggerate the actual benefit. The NNT as a measure of the absolute effect is now generally recommended to be used when making clinical decisions. The willingness to pay based on the NNT was thus used in this study as the most appropriate description of the true willingness of the public to pay. This allows us to assess by how much willingness to pay when the benefit is described in an NNT may differ from those when the benefit is described in the less preferable ways.

The RRR and NNT used as a measure of the size of the benefit from drug treatment for prevention of major CVD events in 5 years were 36% and 50, respectively. These estimates were derived from the results of a large high-quality randomized trial in China and are similar to those observed in trials in western populations. In questions in which the actual drug cost was referred to, we used $500 RMB as the average annual drug costs estimated from published studies.

### Interview and quality control

Face-to-face interview was used for the entire survey. The survey protocol and informed consent form were approved by clinical ethics committee of Baotou Medical College. After the written informed consent was obtained, residents were interviewed by trained interviewers. The interviewers included two associate professors in public health, four public health post-graduate students and six public health undergraduate students. Two-day training of the interviewers was conducted on the contents of the questionnaire and 1-day on-site training on the procedure of the interview. Particular efforts were made to identify and standardize the best way of describing in local dialect the key terms such as CVD, stroke and heart attack. Typical stroke and myocardial infarction patients were often identified in neighbouring households and used to show what these diseases were like and what consequences (such as disability and costs of treatment and care) they may cause. Visual analogue scales and daily life examples were used to explain matters like risk reduction and NNT.

Forty residents were re-interviewed by one of us (WWZ) to examine the reliability and to identify potential problems. The correlation coefficient in five key continuous variables such as the self-perceived risk of CVD was 0.78 (p<0.001).
CVD risk and the NNT below which they would pay for the treatment between the two interviews was all above 0.95. Any suspect interviews were assessed by the principal interviewer (WWZ) to identify problems that could be prevented in future interviews. For example, the interview normally took ~25 min. However, a few initial interviews that were completed too fast were found to have missed some important necessary explanations to the interviewees. These interviews were re-conducted.

A list of all households with the number of household members available was obtained from the local government before the survey started and a local doctor helped find and introduce interviewers to each household. Up to three visits were made to one household if previous visits failed to interview the eligible resident. A written consent form was signed by the interviewee before the interview began.

Statistical analysis
Data were double entered and compared for consistency with Epidata 3.0. Errors were corrected. SPSS 13 was used for statistical analysis. Unless stated otherwise, median was used to describe continuous variables, and percentage to summarize categorical variables. The non-parametric Mann–Whitney test was used to compare two groups and Kruskal–Wallis test for three or more groups. The statistical significance level was set at 0.05 and 95% confidence interval (95% CI) was computed wherever necessary. When the total number is smaller than 1808 in an analysis, it means that there are missing values in the variables involved.

The residents were asked to estimate their 5-year risk of developing a major CVD event when with and without drug treatment. Based on these two estimated risks, we computed the RRR and absolute risk reduction as an estimate of the benefit of treatment. Wherever necessary, given an NNT, the corresponding CVD risk was computed to be 1/(NNT × RRR), where the RRR was assumed to be 36% according to the large trial in the Chinese population and kept the same in all computations.

Role of the funding source
The sponsors of the study had no role in study design, data collection, data analysis, data interpretation or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results
Characteristics of subjects
Of the 1984 potentially eligible residents, 55 had a doctor-diagnosed CVD, 71 could not understand the questions and 1858 were truly eligible. Fifty declined the interview, and 1808 residents were successfully interviewed with a response rate >97% in both the urban and rural areas. Table 1 shows the demographic and socio-economic characteristics of the study subjects by area of residence. Importantly, the percentage of illiteracy and average household income were close to the national average.

CVD risk in hypertension and benefit from drug treatment perceived by residents
The residents thought that they would have a 70% (95% CI 68–71%) chance of developing a major CVD event in 5 years if they had hypertension and were not treated, which was approximately 12 times that estimated based on a large randomized trial conducted in China (Table 2). They believed that drug treatment of hypertension could lower this risk by an absolute value of 40% (95% CI 39–41%), which is 20 times the best research-based estimate. These two estimates by residents give rise to an RRR of 60% (95% CI 58–61%), as compared with the actual 30% shown in most clinical trials. There was no statistically significant difference in these estimates between rural and urban residents (P > 0.05).

Percentage of residents who were willing to pay for anti-hypertensive drugs
Unsurprisingly, given their significantly over estimated risk and benefit, 95.0% (95% CI 93.9–95.9%) of people said they would take up anti-hypertensive drugs at their own cost if they had hypertension before we gave them any information (Table 3). When asked why they would take the drugs, 92.1% (95% CI 90.8–93.4%) said it was because that was what happens at the doctors. Despite this, 90.5% (95% CI 89.1–91.8%) of the residents said they did not have sufficient knowledge to make a decision. In fact, only 22.4% (95% CI 20.5–24.4%) of the residents knew correctly that the primary objective of anti-hypertensive drugs was to prevent coronary heart disease (CHD) and stroke rather than simply to lower blood pressure or alleviate symptoms, with 8.9% (95% CI 7.7–10.3%) who had no idea at all.

When we told the residents, in a general manner, the actual costs, benefits, risks and opportunity costs of anti-hypertensive drugs (see item 1 of Box 1), the percentage of people who would pay decreased from 95.0 to 45.1% (95% CI 42.8–47.4%) (Table 3). This percentage increased to 59.7% (95% CI 57.4–61.9%) when we presented the benefit in preventing CVD events in an RRR, and further decreased to 22.9% (95% CI 21.0–24.8%) when we presented the same information in an NNT. The NNT also made a difference in residents’ willingness to pay between the rural and urban residents (P < 0.001).

The amount of money the residents were willing to pay for anti-hypertensive drugs
The amount of money people were willing to pay was highly related to how the information was presented...
Table 1 Characteristics of 1808 surveyed subjects by area of residence

<table>
<thead>
<tr>
<th>Characteristics of residents</th>
<th>Urban residents ( (n = 921) )</th>
<th>Rural residents ( (n = 887) )</th>
<th>Total ( (n = 1808) )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (mean ± SD)</strong></td>
<td>50.7 ± 10.7</td>
<td>47.8 ± 8.8</td>
<td>49.3 ± 9.9</td>
</tr>
<tr>
<td><strong>Average family members (mean ± SD)</strong></td>
<td>2.8 ± 0.9</td>
<td>3.6 ± 2.8</td>
<td>3.3 ± 2.1</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td>488 (53.0)</td>
<td>413 (46.6)</td>
<td>901 (49.8)</td>
</tr>
<tr>
<td><strong>Married</strong></td>
<td>851 (92.4)</td>
<td>819 (92.3)</td>
<td>1670 (92.4)</td>
</tr>
</tbody>
</table>

**Education level**

- **Illiterate**
  - Urban residents: 48 (5.2)
  - Rural residents: 156 (17.6)
  - Total: 204 (11.3)

- **Primary (≤5 years)**
  - Urban residents: 137 (14.9)
  - Rural residents: 229 (25.8)
  - Total: 366 (20.2)

- **Junior high (7 years)**
  - Urban residents: 385 (41.8)
  - Rural residents: 383 (43.2)
  - Total: 768 (42.5)

- **Senior high (9 years)**
  - Urban residents: 259 (28.1)
  - Rural residents: 117 (13.2)
  - Total: 376 (20.8)

- **College or above (>9 years)**
  - Urban residents: 91 (9.9)
  - Rural residents: 1 (0.1)
  - Total: 92 (5.1)

- **All**
  - Urban residents: 921 (100.0)
  - Rural residents: 887 (100.0)
  - Total: 1808 (100.0)

**With basic insurance coverage**

- Urban residents: 559 (60.7)
- Rural residents: 552 (62.2)
- Total: 1112 (61.4)

**Median annual household income in $ RMB**

- Urban residents: 23500
- Rural residents: 9500
- Total: 16500

**Self-reported hypertension**

- Urban residents: 166 (18.0)
- Rural residents: 103 (11.6)
- Total: 269 (14.9)

**Self-reported hyperlipidemia**

- Urban residents: 121 (13.1)
- Rural residents: 55 (6.2)
- Total: 176 (9.7)

**Self-reported diabetes**

- Urban residents: 51 (5.5)
- Rural residents: 14 (1.6)
- Total: 65 (3.6)

**Family history of CVD**

- Urban residents: 289 (31.4)
- Rural residents: 249 (28.1)
- Total: 538 (29.8)

**Current smokers**

- Urban residents: 300 (32.6)
- Rural residents: 428 (48.3)
- Total: 728 (40.3)

aThe difference between urban and rural residents is statistically significant \( (P < 0.05) \) for all the variables except marital status and family history of CVD.

bUrban residents were covered by Basic Health Insurance for Urban Workers (56.6%) and Government Employee Health Insurance (4.1%) and rural residents were covered by Rural Cooperative Health Insurance (61.6%) and other types of insurance (0.7%).

Table 2 Self-perceived 5-year CVD risk in untreated hypertension and estimated risk reduction from drug treatment as compared with reference values, by area of residence

<table>
<thead>
<tr>
<th>Risk and benefits</th>
<th>References(^a)</th>
<th>Urban residents ( (n = 919) )</th>
<th>Rural residents ( (n = 882) )</th>
<th>Total ( (n = 1801) )</th>
<th>( P)-value for urban-rural difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-year CVD risk (%)</td>
<td>6</td>
<td>60.0 (50.0, 80.0)</td>
<td>70.0 (50.0, 80.0)</td>
<td>70.0 (50.0, 80.0)</td>
<td>0.369</td>
</tr>
<tr>
<td>Absolute risk reduction in 5 years (%)</td>
<td>2</td>
<td>40.0 (20.0, 50.0)</td>
<td>40.0 (20.0, 50.0)</td>
<td>40.0 (20.0, 50.0)</td>
<td>0.150</td>
</tr>
<tr>
<td>RRR in 5 years (%)</td>
<td>36</td>
<td>60.0 (50.0, 75.0)</td>
<td>60.0 (50.0, 75.0)</td>
<td>60.0 (50.0, 75.0)</td>
<td>0.566</td>
</tr>
</tbody>
</table>

\(^a\)The reference values are derived for average Chinese hypertensive patients from the results of a large trial in Chinese.

Table 3 Percentage and 95% CI of residents willing to pay the current actual cost of $500 RMB a year for anti-hypertensive drugs by method of describing the benefit from treatment and area of residence

<table>
<thead>
<tr>
<th>The method and sequence for describing the benefit</th>
<th>Percentage and 95% CI</th>
<th>( P)-value for urban-rural difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban residents ( (n = 920) )</td>
<td>Rural residents ( (n = 887) )</td>
<td>All ( (n = 1807) )</td>
</tr>
<tr>
<td>1. No description</td>
<td>92.8 (91.0–94.4)</td>
<td>97.2 (95.9–98.1)</td>
</tr>
<tr>
<td>2. Described generally</td>
<td>43.9 (40.7–47.1)</td>
<td>46.3 (43.1–49.6)</td>
</tr>
<tr>
<td>3. Described in RRR</td>
<td>61.2 (58.0–64.3)</td>
<td>58.2 (54.9–61.4)</td>
</tr>
<tr>
<td>4. Described in NNT</td>
<td>29.9 (26.9–32.9)</td>
<td>15.5 (13.2–17.8)</td>
</tr>
</tbody>
</table>
The residents were, on average, willing to pay for anti-hypertensive drugs only when the NNT for 5 years was 8 (95% CI 4–12) or smaller or equivalently when the 5-year CVD risk was 34.7% (95% CI 31.1–38.2%) or greater. The corresponding NNT and risk were 12.7 and 21.9% in urban residents and 5.5 and 50.5% in rural residents.

**Discussions**

Why do we treat—for the disease or an outcome? The question may not be a matter of concern for diseases like acute myocardial infarction and pneumonia, which are immediate causes of suffering or impose a high and immediate risk of disability or mortality. For many other diseases like hypertension the question would be crucial in making decisions about treatment. Hypertension is not a disease in that sense but only a factor that increases probabilistically the risk of developing a major CVD event in the future. The fact that the majority of hypertensive patients do not suffer any complications and symptoms from elevated blood pressure in their entire lifetime suggests that many do not need drug treatment. Traditionally, this important distinction has not been made clearly between hypertension and other diseases. This has led to a wide misconception that elevated blood pressure itself is a sufficient reason for treatment and possibly to an over-treatment of hypertension. This study showed that 95% of the residents felt hypertension had to be treated with drugs. This is probably largely because of their inadequate knowledge on the risk of hypertension and the benefit of treatment. They believed that if they had hypertension and were not treated, they would have a 70% chance of developing a major CVD event in 5 years, which is approximately 12 times their actual risk. They also believed that anti-hypertensive drugs would lower this risk from 70% to 30%, which is equivalent to an absolute risk reduction of 40% and an RRR of 60% as compared with their actual risk reduction of 2 and 36%, respectively.

These results show how poorly these residents are informed on hypertension. Given the economic, medical and educational status of the surveyed population, these results are likely to reflect the general trend in China. This is, however, not a phenomenon only in China. The risk of hypertension and the benefit of treatment are commonly over-stated by the public and patients worldwide. A UK study found that elderly hypertensive patients believed that stroke risk was >40% in 5 years if their hypertension was not controlled. They also mistakenly thought that anti-hypertensive drugs could lower their risk by >50%. Similarly, a large study in The Netherlands found 45% of 1194 patients with hypertension or diabetes over-rated their 10-year risk of myocardial infarction and stroke by an absolute

![Figure 1](https://via.placeholder.com/150)

**Figure 1** Cumulative percentage of residents willing to pay a certain cost for anti-hypertensive drugs given the actual benefit presented in three different ways (n = 1807)

(Figure 1): it was lowest when the benefit was presented in an NNT and highest when presented in an RRR (P < 0.01). On average, the residents were not willing to pay more than $469 (95% CI $414–524) RMB (similar to the current actual cost of $500 RMB) a year when the benefit was generally described, not more than $698 (95% CI $583–813) RMB when the benefit was presented in an RRR, and not more than $47 (95% CI $31–125) RMB when the benefit was presented in an NNT.

Furthermore, when the benefit was presented in an NNT, 46.7% (95% CI 44.4–48.9%) of residents said that they would not pay a single dollar for anti-hypertensive drugs and 82.9% (95% CI 81.1–84.6%) were not willing to pay $500 RMB (the current actual cost) or more in a year for this treatment. On average, the urban residents were willing to pay $111 (95% CI $28–250) RMB a year, whereas the median amount of money the rural residents were willing to pay was nil.

**The risk above which the residents were willing to pay for anti-hypertensive drugs**

When asked above what benefit they would consider taking anti-hypertensive drugs at a cost of $500 RMB a year (the current actual cost), only 22.9% (95% CI 21.0–24.8%) of the residents were willing to pay for anti-hypertensive drugs at the NNT of 50 for 5 years or greater, the actual size of benefit they were likely to gain on average from the treatment (Table 4). The corresponding percentage was 29.9% (95% CI 26.9–32.9%) for urban residents and 15.5% (95% CI 13.2–17.8%) for rural residents.
value $>20\%$ as compared with the actual risk projected according to the risk factors they had. We then told the residents that the primary objective of anti-hypertensive drugs was to prevent major CVD events rather than simply reducing blood pressure or relieving symptoms as they commonly believed, and they must take into account their needs, available resources and opportunity costs in making the decision. We also told them that drugs could only prevent, on average, one major CVD event in 5 years’ time in every 50 hypertensive persons treated, namely, an NNT of 50 in 5 years. After being thus informed, the percentage of residents who were still willing to pay for anti-hypertensive drugs dropped from 95 to 23%, a 76% reduction.

Interestingly, when we explained to the residents the NNT was about 50 for 5 years, one of them became furious. He accused of us telling them lies about the benefit of anti-hypertensive drugs and declined to give us any further information. He said that the benefit could in no way be as small as we described. This story shows that some residents’ knowledge about hypertension could be poor and cause them to make inappropriate decisions about drug treatment.

After being appropriately informed, the residents were only willing to pay, on average, some $47$ RMB a year for the drugs, which was only 9% of the actual costs. The rural residents, 47% said they would not pay a single dollar for the drugs, given their actual absolute benefit. On average, the residents were willing to pay only when the NNT for 5 years was 8 or smaller, or equivalently when the 5-year CVD risk was 34.7% or higher. This is a risk over three times the treatment cutoff recommended for New Zealand and UK populations. In fact, very few people would have a 5-year risk this high if they did not have a history of a major CVD event.

As compared with our findings, western populations tend to accept anti-hypertensive drugs for an NNT much closer to the actual NNT demonstrated in randomized controlled trials. For example, a UK study found that the majority of patients would consider drug treatment if their personal chance of avoiding death by taking treatment for the next 5 years was 1 in 33. Another study in the UK found most people would accept preventive drug treatment if it could prevent one myocardial infarction in 5 years in every 40 treated.

### Table 4 Percentage of residents willing to pay the current annual costs of $500$ RMB for anti-hypertensive drugs given a hypothetical benefit or larger and its corresponding 5-year CVD risk

<table>
<thead>
<tr>
<th>NNT for 5 years as a measure of the benefit</th>
<th>Corresponding 5-year CVD risk (%)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Urban residents &lt;i&gt;(n = 920)&lt;/i&gt;</th>
<th>Rural residents &lt;i&gt;(n = 883)&lt;/i&gt;</th>
<th>All residents &lt;i&gt;(n = 1803)&lt;sup&gt;d&lt;/sup&gt;&lt;/i&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency (%)</td>
<td>Cumulative (%)</td>
<td>Frequency (%)</td>
<td>Cumulative (%)</td>
</tr>
<tr>
<td>≥1000</td>
<td>0.3</td>
<td>91 (9.9)</td>
<td>32 (3.6)</td>
<td>6.8</td>
</tr>
<tr>
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<td>23 (2.5)</td>
<td>12 (1.4)</td>
<td>5.0</td>
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<tr>
<td>200</td>
<td>1.4</td>
<td>27 (2.9)</td>
<td>8 (0.9)</td>
<td>5.9</td>
</tr>
<tr>
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<td>2.8</td>
<td>70 (7.6)</td>
<td>27 (3.1)</td>
<td>8.9</td>
</tr>
<tr>
<td>50 (actual NNT)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.6</td>
<td>64 (7.0)</td>
<td>58 (6.6)</td>
<td>15.5</td>
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<tr>
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<td>21 (2.4)</td>
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<tr>
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<td>13.9</td>
<td>108 (11.7)</td>
<td>69 (7.8)</td>
<td>25.7</td>
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<tr>
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<td>21 (2.4)</td>
<td>28.1</td>
</tr>
<tr>
<td>10</td>
<td>27.8</td>
<td>96 (10.4)</td>
<td>102 (11.6)</td>
<td>39.6</td>
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<td>30.9</td>
<td>3 (0.3)</td>
<td>2 (0.2)</td>
<td>3.9</td>
</tr>
<tr>
<td>8</td>
<td>34.7</td>
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<td>5 (0.6)</td>
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<tr>
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<td>1 (0.1)</td>
<td>3 (0.3)</td>
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<td>92.6</td>
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<td>95 (10.8)</td>
<td>68.7</td>
</tr>
<tr>
<td>2</td>
<td>N/E&lt;sup&gt;c&lt;/sup&gt;</td>
<td>173 (18.8)</td>
<td>211 (23.9)</td>
<td>92.6</td>
</tr>
<tr>
<td>1</td>
<td>N/E&lt;sup&gt;c&lt;/sup&gt;</td>
<td>89 (9.7)</td>
<td>65 (7.4)</td>
<td>100.0</td>
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</table>

<sup>a</sup>The corresponding 5-year CVD risk = 1/(NNT x RRR), where RRR is assumed to be 36% as shown in Table 2, an estimate that represents the RRR for average Chinese hypertensive patients.

<sup>b</sup>The NNT of 50 for 5 years represents the best estimate of the actual benefit in average Chinese hypertensive patients.

<sup>c</sup>N/E = not estimable.

<sup>d</sup>There are five missing values.
Furthermore, Hux et al.\textsuperscript{35} showed that in Canada, when the results of Helsinki Heart Study were presented to patients, 31\% of hypertensive patients said that they would take the medication given the NNT of 71, namely, 71 persons needed to be treated for 5 years in order to prevent one heart attack. In our study, only 23\% were willing to pay for the treatment at an NNT of 50 for 5 years, a benefit larger than the NNT of 71 for 5 years.

The difference between our study and those in western countries may be partly because we assumed that the residents have to pay from their own pocket whereas patients in other studies do not. Thus, it is anticipated that the willingness to pay in the western counties would be lower than that shown in the aforementioned studies if the drugs were not provided for free. However, more importantly, providing a drug for free is mostly a decision of the healthcare providers and/or politicians and may not truly reflect the will of people. The willingness to take a drug irrespective of its costs thus avoids the fundamental question of whether or not the drug should be provided for free at the cost of the public.\textsuperscript{15} In many other communities as well as in China, many patients have no option but to pay for anti-hypertensive drugs out of pocket.

Although it is generally suggested to consult the general public rather than patients in surveys of this kind,\textsuperscript{36} it may still be argued that when they are ill they may have a different opinion. However, the results in this study remained largely the same in the 269 participants with self-reported hypertension diagnosed by a doctor. Before they were properly informed, 91\% felt hypertension needed to be treated. They believed that they would have a 70\% chance of developing a major CVD event in 5 years if their hypertension was not treated. They estimated the absolute risk reduction and RRR to be 40\% and 63\%, respectively. After we told them the actual NNT of the treatment, only 16\% said they were still willing to pay for the drugs and the median 5-year CVD risk above which they would consider to pay was 28\%.\textsuperscript{37}

Other biases may also exist in the study. First, as only one city is selected, even though the city represents the national average in education, medical services and economy, the results may not represent very well the national perspective even if the surveyed city and the areas were randomly selected. Secondly, we did not directly include the cost of treating stroke and coronary heart disease as an opportunity cost if anti-hypertensive drugs are not used. This could lead to under-estimation of the willingness to pay for anti-hypertensive drugs. However, before asking the residents for their willingness to pay for anti-hypertensive drugs, we informed the residents that, if their hypertension is not effectively controlled, stroke and coronary disease may occur and costs of treating them may be incurred. The bias, if any, should not be large. Finally, people’s willingness to pay may change when they become richer or poorer and when the price of the drugs changes. Thus, the results of this study in 2005 would not apply to the same population in the future and will not apply to populations for which the drug price is much lower or higher.

Importantly, we argue that the implications of the findings on the people’s willingness to pay for hypertension in this study would apply to all those that are continuous risk factors but taken as discrete disease entities, as such as hyperlipidemia, early stage of type 2 diabetes mellitus and osteoporosis. As blood cholesterol or glucose increases, or bone mineral density decreases, the risk of complications that are real concerns to patients will increase and the benefit from treatment will potentially increase as well. A change in the cutoff will change the number of people who will be put on medications. As different populations have different resources at their disposal, there are no universal cutoff values that can be used to define these ‘diseases’ to suit all populations.

By comparing people’s willingness to pay when they were informed of the benefit in different ways, we also showed a considerable framing effect of the relative benefit,\textsuperscript{23,35} and found that when the benefit was presented in an RRR the willingness of the residents to pay was similar to that when the benefit was described generally and a few times higher than that when the benefit was expressed in an NNT.

It is probably hard for many in developed countries to understand why these poor people could decline these life-saving drugs. Jerald Brenan seemed to have an answer many decades ago: ‘Those who have some means think that the most important thing in the world is love. The poor know that it is money.’ Furthermore, what is in the drugs is not all love to the patients; drugs can do harm and are also related to the profits of drug companies. Given the resources they have, many other more urgent problems they face, and the costs of the drugs that can consume a large proportion of their entire household income, it is unlikely poor people would take seriously the drugs with this size of impact.

In conclusion, the public in China are poorly informed and significantly over-rate the risk of hypertension and the benefit from treatment. The RRR could be misleading and the public should be informed of the benefit in absolute terms in order for them to make a sensible choice within the constraints of available resources. That only 23\% of people are willing to pay for anti-hypertensive drugs given its absolute benefit is a strong call for a review of the current drug policies on primary prevention of CVD, in particularly in developing countries.

These findings lend further support to the principle in decision making that the evidence of effectiveness alone cannot be used as sufficient evidence for action; resources and values must also be considered
in making recommendations. As available resources and values differ from population to population, guidelines made for one population (or patient) cannot be directly applied to a different population (or patient). Recommendations must be tailored according to local resources, needs and values.

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References

Cardiovascular disease is a leading cause of death in most countries throughout the world and it presents a challenge to developing countries like China. Changes in lifestyle and ageing populations raise the importance of active prevention strategies focusing on known cardiovascular risk factors. One of these, high blood pressure, has already been named among the top 10 leading risk factors in the global burden of disease, but Tang et al. claim in this issue of IJE that the willingness of the Chinese population to pay for antihypertensive drugs does not support treatment based on a diagnosis using the current cut-offs in blood pressure levels.

In 1985, Geoffrey Rose outlined two strategies for dealing with risk factors in any population—the individual or high-risk approach and the population approach. There are many arguments in favour of the population approach, which aims to shift the population distribution of a potential risk factor such as blood pressure to a more protective level through lifestyle change and government measures such as legislation on food composition. The high-risk approach, on the other hand, targets those above a certain level of risk of disease; for cardiovascular disease, nowadays, this would normally be determined by multiple risk factors rather than by single risk factor such as blood pressure level. Tang et al. asked their respondents about their willingness to pay (WTP) for antihypertensive treatment after presenting them with differing descriptions of the potential benefits to be gained. These different descriptions included a general statement about benefit, relative risk reductions (RRRs) and number needed to treat (NNT). While the specific interpretation of their findings could be debated, the paper raises some relevant questions and reminds us of several important issues in tackling cardiovascular risk factor reduction in any population.

First, the ways of presenting the effects of treatments greatly affects the public’s or the patient’s perception of benefit. Tang et al. found that the WTP for the benefit ranged from 698 RMB (US$102) to 47 RMB (US$7) for the same effects presented as RRRs compared with presenting them as NNT. Since many of the individuals being considered for antihypertensive treatment in this study were of acceptance of drug therapy to prevent myocardial infarction. Br J Clin Pharmacol 1999;47:580.

