The Chinese physicians’ Cardiovascualr Risk Evaluation (CARE) survey: an assessment of physicians’ own cardiovascular risks

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ABSTRACT

Objective To estimate the 10-year risk of cardiovascular disease (CVD)/coronary heart disease (CHD) in physicians using two models (the Chinese and Framingham models).

Methods This was a multicentre, cross-sectional survey, which recruited cardiovascular physicians from 386 medical centres in all 31 provinces and municipalities in China. Cardiovascular risk factors such as body mass index, blood pressure and cholesterol were recorded during enrolment. Control rates (%) of hypertension, hypercholesterolaemia and diabetes were defined according to guidelines. Participants aged ≥35 years completed the Framingham model and participants aged ≤59 years completed the Chinese prediction model.

Results A total of 820 (41.5%) women and 1598 (78.7%) men had ≥1 markedly raised CVD risk factors. The Chinese prediction model showed that 22 (1.2%) women and 143 (7.6%) men had a 10-year risk of ischaemic CVD ≥5%, and an above-average level of 10-year ischaemic CVD risk factors was found in 20.6% of women and in 54.6% of men. When the Framingham model was used, 268 (13.6%) women and 724 (35.7%) men had a 10-year absolute risk of CHD ≥5%.

Hypertension, diabetes and hypercholesterolaemia were only controlled in 58.2%, 46.6% and 38.5% of participants, respectively. Only 30.3% of physicians with a 10-year risk of CHD ≥10% were using aspirin.

Conclusions The results show suboptimal awareness in physicians of their own cardiovascular risks, and low use of prophylactic agents. Improvement of physicians’ risk factors in will improve their ability to act as role models in the promotion of primary and secondary prevention initiatives.

China has one of the highest cardiovascular disease (CVD) death rates in the world, which may be linked to the epidemiological transition (ie, lifestyle and diet changes and increased life expectancy) that is now taking place as a result of the country’s ongoing economic transformation.1–4 In order to effectively reduce this burden, the European guidelines on CVD prevention in clinical practice and the guidelines on prevention and treatment of dyslipoproteinaemia in Chinese adults emphasise the need for total risk factor assessment and management.5–6

The Framingham Heart Study investigators have devised a model for predicting the risk of coronary heart disease (CHD) and, therefore, identifying those patients that would benefit from preventive actions.7 As stroke is much more prevalent than CHD in China, Wu et al have also developed and validated an ischaemic CVD risk estimation model specific to the Chinese population (the Chinese prediction model), which takes this difference into account.8

The aim of this survey was to estimate 10-year CVD/CHD risk using the Chinese prediction and Framingham models in Chinese cardiovascular physicians. Both risk evaluation tools were included as the Framingham model is used in Chinese guidelines to determine prophylactic agent use (ie, the Chinese expert consensus recommends using aspirin to prevent serious events in the long term for patients who have a 10-year CHD risk ≥10% as predicted by Framingham model and who have cardiovascular events)9 and the Chinese prediction model is specific to the Chinese population.

METHODS

Design and population

The aim of this multicentre, cross-sectional survey (IRB (Institutional Review Board) of Tongji University authorised no.: LL(H)-08-01) was to estimate 10-year CVD/CVD risk using the Chinese prediction and Framingham models.7 8 in a random sample of Chinese cardiovascular specialists aged ≥35 years without CHD, ischaemic stroke, transient ischaemic attacks, peripheral arterial disease, atrial fibrillation, carotid stenosis and other diseases of thromboembolism. The physicians were randomly selected using multistage (stratified cluster) sampling from 386 centres in all 31 provinces and municipalities in mainland China between 1 June 2008 and 31 August 2008; this approach ensured that the sample was representative of cardiovascular physicians across all regions in China (including urban and rural regions). The survey was performed in accordance with the Declaration of Helsinki and the data collection protocol was approved by the Tongji University Research Ethics Committee. All participants provided written informed consent that allowed access to their medical records.

Data collection and assessments

At each medical centre, one physician was trained by the Chinese physicians’ Cardiovascular Risk Evaluation (CARE) survey group on how to complete the Chinese prediction and Framingham models for each participant in that centre; this ensured that the approach was standardised across all centres. At the start of the survey, trained physicians completed case report forms for all subjects, and monitors then checked all completed forms against original medical records.

Cardiovascular risk factors (such as age, sex, smoking status, diabetes) were recorded on the case
which base aspirin recommendations according to CHD risk on the Framingham model.

**Statistical analysis**

All data recorded on the case report forms were entered into two Epidata (http://www.epidata.dk) 3.02 databases by different people and were crosschecked. The data were analysed using SPSS statistical software V.14.0 (SPSS, Chicago, Illinois, USA). The differences in continuous variables (ie, age, BMI, fasting glucose, blood pressure, TC, LDL-C and HDL-C) between groups were examined by Student t test or the Wilcoxon (Mann–Whitney) rank sum test. The differences in discrete variables (ie, current smoking, diabetes, hypertension and hypercholesterolaemia) between groups were tested by the Pearson $\chi^2$ test. Correlation analysis between absolute 10-year risk, RR and age were based on Spearman rank (r) correlation (Chinese prediction model only). The Jonckheere–Terpstra test (J-T test) was used to evaluate the proportion of physicians with RR $>$ 1 compared with average risk and with lowest risk stratified according to age and gender. Any missing or incomplete values were excluded from risk factor analyses.

**RESULTS**

**Baseline characteristics**

A total of 4032 physicians were enrolled in the study (figure 1). The population characteristics and risk factors are shown in table 1; 49% of participants were women and 51% of participants were men. A total of 820 (41.5%) women and 1598 men

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**Estimation of the 10-year risk of ischaemic CVD using the Chinese prediction model**

A standard evaluation sheet for predicting the 10-year risk of ischaemic CVD was completed by physicians aged 35–59 years. This evaluation sheet, which forms the basis of the Chinese prediction model, was first validated using data from the USA–People’s Republic of China Collaborative Study of Cardiovascular and Cardiopulmonary Epidemiology (USA-PRC) cohort (n = 17 529 Chinese adults).

- The sheet uses age, blood pressure, BMI, cholesterol, smoking and diabetes to determine a total score, which is used to estimate the 10-year risk of ischaemic CVD. This model estimates that if the total score is $\geq 16$ (men) or $\geq 14$ (women), then the 10-year absolute risk of ischaemic CVD will be $\geq 54.9\%$ (men) and $\geq 49.2\%$ (women); these thresholds were also used in the current survey, and no modifications were made.

- The 10-year relative risk (RR) of ischaemic CVD according to physician age and gender was then compared with the USA-PRC cohort and stratified according to standard average risk or lowest risk. The standard average risk was defined as the average risk in the same sex and age group of the USA-PRC cohort, and the standard lowest risk was calculated for a non-smoker of the same age, same gender, systolic blood pressure $< 120$ mm Hg, BMI $< 24$ kg/m$^2$, total cholesterol $< 5.17$ mmol/litre and with no diabetes. RR was defined as the absolute total of 10-year risk of ischaemic CVD divided by standard average or lowest risk.

**Estimation of the 10-year CHD risk using the Framingham model**

The Framingham model CHD score evaluation sheets for men and women were used to estimate the 10-year CHD risk for the physicians aged 35–74 years in this survey. This evaluation sheet was validated using data from the Framingham Heart study. This sheet uses age, cholesterol, blood pressure, diabetes and smoking to determine a total score, which is then used to estimate the 10-year risk of CHD. This model estimates that if the total (LDL-C) score is $\geq 14$, then the 10-year CHD risk is $\geq 55\%$. Although the age of inclusion in our study was $\geq 35$ years, no modifications were made to the model, which has a scoring system for subjects aged 30–74 years. Aspirin use for disease prevention was stratified according to CHD risk obtained by the Framingham model (but not the Chinese prediction model). This was to be consistent with the China guidelines, which base aspirin recommendations according to CHD risk on the Framingham model.
(78.7%) had ≥1 CVD risk factors. Smoking, obesity, diabetes, hypertension and hypercholesterolaemia were significantly higher in men than women (all p<0.01; smoking: p<0.001).

Estimation of the 10-year risk of ischaemic CVD using the Chinese prediction model

In total, 4.3% of physicians had a 10-year absolute risk of ischaemic CVD ≥5%. When stratified according to sex, 22 (1.2%) women and 143 (7.6%) men had a 10-year absolute risk of ischaemic CVD ≥5%. The median 10-year absolute risk was 1.4% and 0.20% for men and women, respectively (table 2). The absolute risk increased with age in men (Spearman r=0.564, p<0.001) and women (Spearman r=0.675, p<0.001), and the risk remained significantly higher for men than women in all age groups (table 2).

The 10-year RR of ischaemic CVD in comparison with the standard average risk is shown in table 3. The RR was >1 for men in all age groups, indicating that the risk level was higher than that estimated for a general population. The RR was >1 for women aged over 45 years, which indicates that older women had a higher risk level than that observed for a general population. In total, 20.6% of female physicians and 54.6% of male physicians had a 10-year RR that was more than the standard average risk. Compared with the standard average risk, the proportion of physicians with a RR>1 significantly increased with age in men (standard J-T=12.467, p<0.001) and women (standard J-T=2.457, p=0.014).

The 10-year RR of ischaemic CVD in comparison with the standard lowest risk is shown in table 3; the RR was >1 for men and women in all age groups, which implied that the 10-year RR of ischaemic CVD for men and women in all age groups was higher than the standard lowest risk. In total, 90.5% of men and 57.6% of women had a 10-year RR that was more than the standard lowest risk, and the proportion of physicians with a RR>1 significantly increased with age in men (standard J-T=13.460, p<0.001) and women (standard J-T=14.011, p<0.001).

Estimation of the 10-year CHD risk using the Framingham model

In total, 24.8% (268 (15.6%) women and 724 (35.7%) men) had a 10-year absolute risk of CHD ≥5% according to the Framingham model. The median 10-year absolute risk was 4% and 2% for men and women, respectively (table 2). The risk increased with age in men and women, and the risk remained significantly higher in men than women.

Control of CVD risk factors

The proportion of physicians (aged 35–59 years) with hypertension control was 58.2% (n=226/388; female: 64.0%, n=80/125; male: 55.6%, n=146/263); the proportion with diabetes control was 46.6% (n=41/88; female: 37.9%, n=11/29; male: 50.8%, n=30/59), and the proportion with hypercholesterolaemia control was 38.5% (n=207/538; female: 43.7%, n=87/199; male 55.4%, n=120/339). The rate of aspirin use among physicians with a 10-year absolute risk of CHD ≥5% and ≥10% (Framingham model) was 16.9% and 30.5%, respectively.

DISCUSSION

In China, cardiovascular physicians play a key role in CVD treatment and prevention, and can also educate patients on
the impact of cardiovascular risk factors, the importance of improving lifestyle and diet and the most effective medical treatments, including prophylaxis where appropriate. Physicians therefore need to be aware of risk estimation models so that they can determine overall risk and provide effective and tailored intervention. However, given the number of available risk estimation tools, using the most accurate ones is still a question for debate, and not all physicians use these tools. An additional aim of this survey was to improve physician awareness of risk factors and estimation tools by self-evaluation of their own risks, with the subsequent aim of improving CVD/CHD prevention in China.

The survey showed that the distribution of risk factors was significantly different between male and female physicians. For example, the prevalence of smoking was 29.8% and 0.2% in male and female physicians, respectively. Previous studies have also shown that smoking is low in female physicians (1.0%) and in the female population in China (3.8%), which was confirmed by this survey; however, the smoking rate in the male physicians was lower than that observed in the general population (63.0%) and in previous studies of male physicians (40.7%). In 1999, the World Health Organization advocated that physicians, as role models for healthy living, should not smoke and that they should not condone patients’ smoking. This could account for the low smoking rates. The prevalence of diabetes was 3.4% overall, which is also less than estimates of the general population in Shanghai (about 8.6%), and in Hong Kong Chinese adults of working age (4.5%, 95% confidence interval: 5.5% to 7.7%). The prevalence of hypertension and hypercholesterolaemia was 12.6% and 35.9%, respectively. The prevalence of hypertension was lower than that found in Chinese adults aged 35 to 74 years (19.4%), but the prevalence of hypercholesterolaemia was higher than that in the Chinese Han population (28.7%). Overall, 4.3% of physicians had a 10-year absolute risk of ischaemic CVD ≥5% when calculated using the Chinese prediction model, and the rates were higher among men than women (7.6% vs 1.2%, respectively). In comparison, 24.8% had a 10-year risk of CHD ≥5% estimated by the Framingham model, and the rates were also higher among men than women.

### Table 2

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chinese prediction model:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>35 to 39</td>
<td>0.70 (0.50 to 1.40)</td>
<td>0.10 (0.10 to 0.20)</td>
<td>0.30 (0.10 to 0.70)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>40 to 44</td>
<td>1.40 (0.70 to 1.90)</td>
<td>0.20 (0.10 to 0.30)</td>
<td>0.60 (0.20 to 1.40)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>45 to 49</td>
<td>1.90 (1.40 to 3.10)</td>
<td>0.40 (0.20 to 0.60)</td>
<td>1.00 (0.40 to 1.90)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>50 to 54</td>
<td>2.60 (1.90 to 5.00)</td>
<td>0.60 (0.40 to 1.40)</td>
<td>1.40 (0.60 to 2.60)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>55 to 59</td>
<td>5.00 (2.60 to 7.00)</td>
<td>1.40 (0.60 to 2.48)</td>
<td>2.20 (1.40 to 5.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Total</td>
<td>1.40 (0.70 to 2.60)</td>
<td>0.20 (0.10 to 0.40)</td>
<td>0.50 (0.20 to 1.40)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>Framingham model:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>35 to 39</td>
<td>3.00 (2.00 to 4.00)</td>
<td>1.00 (1.00 to 1.00)</td>
<td>2.00 (1.00 to 3.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>40 to 44</td>
<td>4.00 (3.00 to 6.00)</td>
<td>2.00 (1.00 to 2.00)</td>
<td>2.00 (2.00 to 4.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>45 to 49</td>
<td>6.00 (4.00 to 7.00)</td>
<td>3.00 (2.00 to 4.00)</td>
<td>4.00 (2.00 to 6.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>50 to 54</td>
<td>7.00 (6.00 to 11.00)</td>
<td>4.00 (4.00 to 6.00)</td>
<td>6.00 (4.00 to 8.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>55 to 59</td>
<td>7.00 (6.00 to 11.00)</td>
<td>4.00 (4.00 to 6.00)</td>
<td>6.00 (4.00 to 8.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>60 to 64</td>
<td>3.00 (2.00 to 6.00)</td>
<td>1.00 (1.00 to 1.00)</td>
<td>2.00 (1.00 to 3.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>65 to 69</td>
<td>4.00 (3.00 to 6.00)</td>
<td>2.00 (1.00 to 4.00)</td>
<td>3.00 (2.00 to 4.00)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>≥70</td>
<td>10.00 (7.00 to 14.00)</td>
<td>7.00 (6.00 to 8.00)</td>
<td>9.00 (6.00 to 11.00)</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

*Denotes significantly different between men and women. CHD, coronary heart disease; CVD, cardiovascular disease.

### Table 3

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard average risk:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 to 39</td>
<td>1.11 (1.04 to 1.17)</td>
<td>0.82 (0.78 to 0.86)</td>
<td>0.96 (0.93 to 1.0)</td>
<td></td>
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<tr>
<td>40 to 44</td>
<td>1.30 (1.22 to 1.37)</td>
<td>0.66 (0.61 to 0.71)</td>
<td>0.99 (0.95 to 1.04)</td>
<td></td>
</tr>
<tr>
<td>45 to 49</td>
<td>1.50 (1.38 to 1.62)</td>
<td>1.03 (0.87 to 1.18)</td>
<td>1.26 (1.16 to 1.36)</td>
<td></td>
</tr>
<tr>
<td>50 to 54</td>
<td>1.59 (1.36 to 1.81)</td>
<td>1.24 (1.06 to 1.18)</td>
<td>1.40 (1.26 to 1.54)</td>
<td></td>
</tr>
<tr>
<td>55 to 59</td>
<td>1.78 (1.50 to 2.07)</td>
<td>1.61 (1.31 to 1.91)</td>
<td>1.69 (1.48 to 1.90)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.31 (1.26 to 1.36)</td>
<td>0.90 (0.86 to 0.95)</td>
<td>1.11 (1.07 to 1.14)</td>
<td></td>
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<tr>
<td></td>
<td>Standard lowest risk:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 to 39</td>
<td>3.32 (3.13 to 3.50)</td>
<td>1.64 (1.57 to 1.71)</td>
<td>2.47 (2.36 to 2.58)</td>
<td></td>
</tr>
<tr>
<td>40 to 44</td>
<td>3.89 (3.67 to 4.10)</td>
<td>2.64 (2.44 to 2.84)</td>
<td>3.30 (3.15 to 3.45)</td>
<td></td>
</tr>
<tr>
<td>45 to 49</td>
<td>4.79 (4.40 to 5.17)</td>
<td>3.08 (2.62 to 3.54)</td>
<td>3.91 (3.61 to 4.22)</td>
<td></td>
</tr>
<tr>
<td>50 to 54</td>
<td>5.21 (4.78 to 5.94)</td>
<td>3.71 (3.19 to 4.23)</td>
<td>4.42 (3.97 to 4.87)</td>
<td></td>
</tr>
<tr>
<td>55 to 59</td>
<td>5.53 (4.66 to 6.41)</td>
<td>4.18 (3.40 to 4.97)</td>
<td>4.81 (4.22 to 5.40)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4.03 (3.88 to 4.17)</td>
<td>2.53 (2.40 to 2.66)</td>
<td>3.28 (3.18 to 3.38)</td>
<td></td>
</tr>
</tbody>
</table>

CVD, cardiovascular disease; RR, relative risk.
(35.7% vs 13.6%). These findings were consistent with those published by Wu et al, which also showed that estimation of ischaemic CVD and CHD was higher in men than women. Over an 11-year follow-up, Wu et al found that ischaemic CVD risk estimation was comparable to the observed incidence of ischaemic CVD, but the estimated CHD risk (recalibrated Framingham model) was high compared with the observed CHD incidence. Our findings also show that estimated CHD risk was high. It is also interesting to note that the USA-PRC cohort (used in Wu et al’s study) had a number of similar characteristics to the physicians in our survey; the mean age was 46 years, the mean systolic blood pressure (SBP)/diastolic blood pressure (DBP) was 119/77 mm Hg, and the mean total cholesterol was 4.6 mmol/litre; however, the USA-PRC cohort had a higher number of smokers (45%) and a lower number of patients with diabetes (2%).

When the findings from our survey were compared with the standard-risk and low-risk estimates based on the USA-PRC cohort, the survey showed that the proportion of men and women with RR >1 (compared with standard risk) was 54.6% and 20.6%, respectively, and the proportion of men and women with RR >1 (compared with low risk) was 90.5% and 57.6%, respectively (ie, a significant proportion of physicians had greater risks than these average-risk and low-risk cohorts). It is possible that factors such as differences in rates of disease control, which were less than optimal in our survey, could have contributed to these differences. Our data clearly indicate that there is substantial potential to reduce cardiovascular risk, even within cardiovascular physicians active in clinical practice, through education and/or research. This is also supported by the low control levels of hypertension, diabetes and hypercholesterolaemia, and the obesity levels (31.5%) observed. The use of agents such as aspirin, which is effective for the prevention of cardiovascular events was also low in higher risk (ie, suitable) subjects. The rate of aspirin use among physicians with a 10-year absolute risk of CHD ≥10% (Framingham model) was 50.3%, which is low given that the Chinese expert consensus recommends aspirin use at this threshold. Aspirin use was lower than that observed in USA adults aged ≥40 years (50%) and in Chinese patients with diabetes (55.5%), but it was comparable to use in Chinese patients with hypertension (21.6%).

However, this cohort survey has a number of limitations that require consideration. Firstly, the inclusion criteria of cardiovascular physicians aged ≥55 years excludes younger physicians; and those with known cardiovascular risks are less likely to participate, which could lead to selection biases. However, age biases were inherent in the risk models used. In addition, the Chinese prediction model was based on fatal and non-fatal ischaemic CVD and on data from those without known CVD. We did not take into account the use of medicine to control blood pressure or total cholesterol, the levels of diastolic blood pressure, LDL-C and HDL-C while predicting the 10-year risk by model. Therefore, the actual cardiovascular health level may be lower than the results of our data. Assessment of all these cardiovascular risk factors would have resulted in a more valid risk assessment but was, for practical reasons, not performed. Finally, we must be cautious of overestimation or underestimation of risk depending on the model used for assessment.

In conclusion, this survey provides significant data on physicians’ own cardiovascular risk. The results show that there is a need for improving their cardiovascular risk profiles as well as their performance of cardiovascular risk estimation. Improvement of physicians’ own modifiable cardiovascular risk factors will also improve their ability to act as a good role model in the promotion of primary and secondary prevention initiatives. For example, a study among French general practitioners showed that those who smoked were less successful in helping patients to comply with anti-tobacco messages. Developing easy-to-use tools and accessible guidelines may also prove to be particularly useful for implementing risk screening in daily clinical practices. Toward this aim, our research group has developed a practical pocket chart to help estimate total risk and RR according to the Chinese prediction model. It will be included in the Chinese guidelines on CVD prevention. This model has now been validated in Wu et al’s study and in this survey, and is specific to the Chinese population; however, Framingham is used in Chinese guidelines to define the threshold at which prophylactic agents such as aspirin should be used. Although there are differences in the risk score obtained by each model, both show that male sex and increasing age contribute to overall risk. To improve adherence to guidelines, it may be helpful to implement educational programmes, and to pursue such initiatives as international and national congresses aimed at cardiovascular physicians and nurses. Further follow-up studies are also planned to determine whether this survey has changed the participants’ risk profiles and whether the tools have been implemented in daily clinical practices.

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Competing interests None declared.

Ethics approval The survey was performed in accordance with the Declaration of Helsinki and the data collection protocol was approved by the Tongji University Research Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES