Evaluation of a systematic cardiovascular disease risk reduction strategy in primary healthcare: an exploratory study from Zhejiang, China

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ABSTRACT

BACKGROUND  In China, cardiovascular disease (CVD) risk reduction strategies are not systematically implemented in primary healthcare (PHC). We conducted an exploratory study to evaluate the preliminary effectiveness of our systematic CVD risk reduction package in one township hospital of Zhejiang.

METHODS  Using the Asian Equation, we selected subjects aged 40–74 years with a calculated 10-year CVD risk of 20% or higher from the existing resident health records and research checkup. The subjects were provided, as appropriate, with the low-dose combination of CVD-preventive drugs (antihypertensive drugs, aspirin, statin), lifestyle modification and adherence strategies monthly. The intervention was piloted for three months in 2012, preceding the conduct of a cluster-based randomized controlled trial (RCT).

RESULTS  A total of 153 (40%) subjects were recruited, with an average total 10-year risk of CVD of 28.5 ± 7.9%. After intervention, the appointment rate was up to 90%. An upward trend was observed for the use of CVD-preventive drugs. The smoking rates significantly reduced from 38 to 35%, with almost no change for salt reduction. The systolic blood pressure (BP) and diastolic BP decreased slightly.

CONCLUSION  A holistic CVD risk reduction approach shows preliminary effects in a rural PHC setting of Zhejiang, China. However, further understanding is needed regarding its long-term effectiveness and feasibility in PHC practices. Our cluster-based RCT will provide the highest level of evidence for the policy development of preventing CVD in a rural PHC of China.

Keywords  cardiovascular disease, China, primary healthcare, risk reduction

Background

China has been experiencing epidemiological transition of a dramatic increase in mortality and morbidity caused by chronic diseases. Cardiovascular disease (CVD) accounts for 38% of total mortality in China,² while the mortality rate for stroke in China is four to six times higher than that of Japan and the USA.² Management and control of the CVD and its related conditions such as hypertension and diabetes have presented great challenges in China. Our recent study found that 6% of rural residents aged between 40 and 75 years had a 10-year CVD risk of 20% or higher.³ The prevalence of diabetes was up to 9.7%, with only 2.7% diagnosed in 2008.⁴ The prevalence

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of hypertension among adults over 18 was estimated to be 18.1% in 2004. Urban areas had a higher prevalence of hypertension than rural areas, while a survey found the prevalence was over 40% among rural residents in Shandong. A national survey showed that only 24% hypertensive patients were aware of their conditions, 19% were on treatment and only 4.5% were under adequate control. Only 20–60% of patients could adhere to anti-antihypertensive drugs.

Chronic disease control has long been neglected from the national and international communities. The health system in China is mainly hospital centered, including CVD care. The diagnosis and treatment of CVD and its related conditions such as diabetes is often provided in hospitals at or above county levels. Primary healthcare (PHC) facilities such as township hospitals and village doctors provide basic and acute care for the residents from the catchment areas. In 2005, China issued an Essential Public Health Service policy (EPHSP) to provide basic public health management and services for the population. This involved the setup of residents’ health records and management of the major public health problems such as chronic diseases by the PHC staff. PHC staff are now required to provide systematic management and follow-up of hypertension and diabetic patients based on the severity of their conditions. However, no operational guidelines are available for the PHC staff to systematically manage these patients. Patients with hypertension, diabetes and other CVD-related conditions mostly receive ad hoc care, prescribed with medications based on patient requests or the family doctor’s knowledge.

By synthesizing information from the China hypertension control guideline and all current evidence available, we have developed a holistic CVD risk reduction approach, which includes screening patients records, recommendation of CVD-preventive drugs and healthy lifestyle and providing adherence support. To date, no study from the developing countries has been published which synthesizes all current evidence on therapeutic and healthy lifestyle interventions to prevent CVD events in a PHC setting. Published CVD prevention interventions in China have mainly focused on lifestyle components. Rural township hospitals as the key PHC providers have not been closely involved to deliver these and other CVD prevention interventions. We conducted an exploratory study to evaluate the preliminary effects of our systematic CVD risk reduction package on improving blood pressure, uptake of CVD-preventive medicine and lifestyle modifications in one township hospital in Zhejiang, China. It constituted an exploratory phase preceding the conduct of a cluster-based randomized controlled trial (RCT) of the intervention in rural Zhejiang, China.

Methods

Setting

This study was conducted in a township hospital of Zhejiang province. Zhejiang is a relatively prosperous province on the east coast with a population of 54 million. CVD was the leading cause of death in Zhejiang. The population-based mortality rate was similar between Zhejiang and China (around 2.0%), and so the prevalence rates of the major CVD risk factors, such as hypertension (around 24% among adults).

Daoxu township hospital served a population of around 50,000. As elsewhere in Zhejiang, a small public health team formed in the township hospital conducted the chronic disease management of one ‘designated’ village (often covering an average population of 1500) based on the EPHS. The team was led by the family doctor, and included the public health doctors, nurses and other auxiliary health staff.

Study participants

The existing resident health records were used to identify subjects with a high risk of CVD using the Asian Equation. The adjusted Asian Equation calculated a person’s % risk of having any CVD event in the next 10 years, based on their gender, age, systolic blood pressure (SBP), total cholesterol (TC) and smoking status. The health records were mainly updated through the biennial health checkup for the enrollees of the New Rural Cooperative Medical Scheme (NCMS, a rural health insurance) and the annual health checkup for people over 60.

We first selected adults aged 40–74 years who held permanent residency in the study township and had a calculated 10-year CVD risk of 20% or higher. The selected age group is based on the international guidelines such as those developed by National Institute for Health and Excellency, UK. The exclusion criteria have been described elsewhere, although in this study we did not exclude those having any CVD events and those without a diagnosis of hypertension and diabetes. All the eligible participants who could be reached by the public health teams and provided the informed consent were invited for a research health checkup in the township hospital.

The checkup included a simple questionnaire investigating the history of CVD-preventive medicine use and lifestyles, and a blood sample test. We recruited the subjects who had a calculated 10-year CVD risk of 20% or higher based on the checkup. These included subjects having a recorded medical history of hypertension, diabetes or any CVDs and without a diagnosis of the above-mentioned diseases. Patient address and contact numbers were routinely recorded, and were used to recruit and trace patients in their follow-ups.
**Intervention**

A simplified, user-friendly and systematic guideline was developed including the recommendation of CVD-preventive drugs; lifestyle modification and adherence support for the subjects with a high risk of CVD (Table 1). This guideline fits within the job descriptions of the township doctors. The details of intervention were reported elsewhere. The intervention was piloted for 3 months from August to October 2012 (Fig. 1).

Ethical approval was sought from the Ethics Committees of University of Leeds and Zhejiang Provincial Centre for Disease Control and Prevention.

**Data collection**

The trained family doctors completed the monthly follow-up consultation forms required by EPHSP, covering information of blood pressure, prescriptions and use of recommended drugs, booked appointments, adherence to drugs and lifestyle. This form enabled the collation of the baseline data before intervention and the follow-up data (Months 1, 2 and 3). The baseline data were supplemented by demographic and socio-economic data from research health checkup questionnaires. The research team conducted quality control of the forms to identify and remedy any missing data and logical mistakes.

**Analysis**

Data were analyzed using SPSS 15.0 (SPSS, Inc., Chicago, USA). Descriptive analysis, chi-square test and McNemar and Wilcoxon tests were employed when appropriate. The key effectiveness indicators included the following:

- The mean change of SBP and diastolic blood pressure (DBP) of subjects, using the traditional mercury sphygmomanometers.
- Change of proportion of patients taking CVD-preventive medicine.
- Change of self-reported adherence to healthy lifestyle change, in this study, smoking cessation rates and daily consumption of cigarettes for smoking subjects and daily

<table>
<thead>
<tr>
<th>Table 1 Systematic CVD risk reduction package</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention components</strong></td>
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<tr>
<td><strong>Contents</strong></td>
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<tr>
<td><strong>Procedures</strong></td>
</tr>
<tr>
<td>Drug therapies</td>
</tr>
<tr>
<td>CVD risk of 20% or higher given a combination of two anti-antihypertensive drugs, a statin and low dose of aspirin Drugs prescribed from essential drug list 30% of the drug costs covered by rural health insurance scheme covered in each consultation</td>
</tr>
<tr>
<td>Record basic information of patients on registration forms Confirm diagnosis according to medical history and physical examination Prescribe a combination of drugs based on patients' physical conditions, e.g. disease, contraindication Conduct disease-related health education Adjust the prescriptions according to disease progress and side effects during monthly follow-ups</td>
</tr>
<tr>
<td>Healthy lifestyle education</td>
</tr>
<tr>
<td>Regular health education consultations provided by family doctors, and reinforced monthly during follow-up appointments Consultations: smoking cessation advice and support, as well as advice on healthy eating (especially salt, sugar and oil reduction)</td>
</tr>
<tr>
<td>Identify healthy lifestyle with the subjects Disseminate relevant health education leaflets Deliver key education messages Provide detailed suggestion to improve specific problems Discuss an action plan with the subjects More common language and easy examples used to educate the low educated old people</td>
</tr>
<tr>
<td>Adherence support</td>
</tr>
<tr>
<td>Treatment supporters, SMS, telephone reminders</td>
</tr>
<tr>
<td>Subjects to visit their family doctors monthly A treatment supporter chosen and educated together with the patient, and was explained on their role to support the patient and encourage drug and lifestyle advice adherence Late attendees of clinical appointment reminded by mobile phone</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Participatory training, refresher training, feedbacks</td>
</tr>
<tr>
<td>Train doctors on counseling skills (using role plays) and data collection Refresher training sessions Interventions feedbacks discussed in the monthly internal meetings of township hospitals</td>
</tr>
</tbody>
</table>
salt intake for each family member. We selected these two as tracers for the lifestyle interventions for easy patient recall and data collection in the busy routine setting.

- Change of adherence to booked appointments, to calculate non/successful attending rates, with the denominator all patients registered including defaulters.

Results

Screening subjects with a high risk of CVD
Daoxu had a population of 50,193, including 46,717 (93%) rural residents. Of total, 39,000 (83%) of the rural residents participated in NCMS. In 2011, 14,139 (36%) attended the NCMS health checkup, including 10,980 (78%) aged 40–74 years. The Asia Equation, helped to identify 721 (6.6%) subjects as having a calculated 10-year CVD risk of 20% or higher. Of 547 (76%) eligible subjects, 393 (72%) attended the research checkup. Finally, 153 (40%) subjects having a recalculated 10-year CVD risk of 20% or higher were recruited into this study (Fig. 2).

General characteristics of the subjects
The mean age of the 153 subjects was 71.4 (3.8), while 117 (77%) were married. One hundred and thirty-nine (91%) received education at the primary school level or below. Each subject had average family members of 2.3 (1.3). The average annual income per capita was RMB12,901 (7,496). The average SBP, TC, FBG and BMI were 153 (12), 4.6 (0.7), 5.5 (1.4) and 24.3 (4.5), respectively. Fifty-seven (37%) were smokers, each consuming 14 (10.3) cigarettes per day. The average 10-year risk of CVD was 28.5% (7.9). Compared with females, males had a significantly lower age ($P = 0.009$), higher marriage rate ($P = 0.001$), higher SBP ($P < 0.001$), lower TC ($P = 0.002$), lower BMI ($P = 0.033$), higher smoking rate ($P < 0.001$) and higher 10-year risk of CVD ($P < 0.001$) (Table 2).

Medical appointments
The rate of medical appointment remained high across the pilot period: 95% in Months 1 and 2, while slightly decreasing to 93% in Month 3 (Table 3).
Use of CVD preventive medicine

An upward trend was observed from baseline to Month 3 regarding the use of the recommended CVD-preventive drugs by different categories (Table 3, Fig. 3).

The proportion of patients who took any of the CVD-preventive drugs steadily increased from baseline to Month 3. In Month 3, the proportion was 84%, significantly higher than baseline (73%, \( P = 0.000 \)).

The proportion of patients who took any two or more of the antihypertensive drugs drastically increased from baseline to Month 1, slightly decreased in Month 2, but drastically increased again in Month 3. In Month 3, the proportion was 41%, significantly higher than baseline (10%, \( P = 0.000 \)).

The proportion of patients who took statin drastically increased from baseline to Month 1, slightly decreased in Month 2, but drastically increased again in Month 3. In Month 3, the proportion was 36%, significantly higher than baseline (1.4%, \( P = 0.000 \)).

The proportion of patients who took aspirin dramatically increased from baseline to Month 3. The
The proportion was 43%, significantly higher than baseline (3.4%, \( P = 0.000 \)).

The proportion of patients who took the low-dose combination of anti-hypertension drugs, statin and aspirin drastically increased from baseline to Month 1, then slightly increased in Month 2, and drastically increased in Month 3. In Month 3, this proportion was 33%, significantly higher than baseline (1.4%, \( P = 0.000 \)).

**Lifestyle changes**

The smoking rate remained at 38% in baseline and Month 1, slightly reduced to 35% in Months 2 and 3. On average, each subject consumed 14–15 cigarettes per day across the pilot period. Following intervention, a significant reduction in the smoking rate was observed in Month 3 (\( P = 0.007 \)), though not for daily consumptions (\( P = 0.880 \), Table 3). The average salt intake of each family member slightly reduced from baseline to Month 2 but increased back to the baseline level in Month 3 (7.6 g, \( P = 0.280 \), Table 3).

**Blood pressure**

The average SBP and DBP steadily decreased from baseline to Months 1 and 2, though slightly went up in Month 3. In Month 3, the average SBP and DBP were 139 (±10) and 81 (±8) mmHg, 5 and 1 mmHg lower than their baselines, respectively (\( P = 0.188; P = 0.784; \) Table 3, Fig. 4).

**Discussion**

**Main findings of the study**

Based on the resident health records, 6.6% of the rural residents of 40–74 years had the average 10-year risk of CVD ≥20%, when compared with 6% in another study.\(^3\) Among those who attended the research checkup, 153 (39%) were recruited, with the average 10-year risk of CVD up to 28.5 ± 7.9%. Following intervention, medical appointments were maintained high as over 90%. An upward trend was observed for the proportion of subjects who took the recommended medicine. In Month 3, the proportions of patients taking any of the CVD-preventive drugs, any two or more of the anti-hypertension drugs, statin, aspirin and the low-dose combination of drugs were 84, 41, 36, 43 and 33%, significantly higher than their baselines. A significant reduction in the smoking rate was observed with almost no change in salt intake and a mild reduction in BPs.
Table 3  Preliminary effect of a systematic CVD risk reduction in primary healthcare

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline (n = 153), % or mean (SD)</th>
<th>Intervention Month 1 (n = 153), % or mean (SD)</th>
<th>Intervention Month 2 (n = 153), % or mean (SD)</th>
<th>Intervention Month 3 (n = 153), % or mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of follow-up</td>
<td>95.4</td>
<td>94.8</td>
<td>92.8</td>
<td>96.1</td>
</tr>
<tr>
<td>Use of CVD preventive medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any of CVD-preventive medicine</td>
<td>72.6</td>
<td>76.6</td>
<td>79.6</td>
<td>84.4(^a)</td>
</tr>
<tr>
<td>Any of anti-hypertension drugs</td>
<td>46.6</td>
<td>50.3</td>
<td>59.9</td>
<td>62.7(^b)</td>
</tr>
<tr>
<td>ACEi or ARB</td>
<td>19.9</td>
<td>31.0</td>
<td>34.5</td>
<td>34.0</td>
</tr>
<tr>
<td>Thiazide diuretic</td>
<td>2.1</td>
<td>14.5</td>
<td>185.5</td>
<td>35.4</td>
</tr>
<tr>
<td>Ca-channel blocker</td>
<td>34.9</td>
<td>31.7</td>
<td>33.1</td>
<td>32.0</td>
</tr>
<tr>
<td>Any of two anti-hypertension drugs</td>
<td>10.3</td>
<td>21.4</td>
<td>20.4</td>
<td>40.8(^c)</td>
</tr>
<tr>
<td>Statin</td>
<td>1.4</td>
<td>14.5</td>
<td>12.7</td>
<td>36.1(^d)</td>
</tr>
<tr>
<td>Aspirin</td>
<td>3.4</td>
<td>13.1</td>
<td>26.1</td>
<td>42.9(^e)</td>
</tr>
<tr>
<td>Low-dose combination of anti-hypertension drugs, statin and aspirin</td>
<td>1.4</td>
<td>8.3</td>
<td>10.6</td>
<td>33.3(^f)</td>
</tr>
<tr>
<td>Lifestyle change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>38</td>
<td>38</td>
<td>35</td>
<td>35(^g)</td>
</tr>
<tr>
<td>Daily cigarette consumption (among smokers)</td>
<td>14 (10.3)</td>
<td>14 (10.3)</td>
<td>15 (10.3)</td>
<td>14 (9.5)(^h)</td>
</tr>
<tr>
<td>Salt intake (g)</td>
<td>7.6 (2.7)</td>
<td>6.9 (3.3)</td>
<td>6.6 (2.8)</td>
<td>7.6 (6.0)(^i)</td>
</tr>
<tr>
<td>Blood pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>144 (16)</td>
<td>139 (15)</td>
<td>137 (11)</td>
<td>139 (11)(^j)</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>82 (9)</td>
<td>81 (8)</td>
<td>80 (8)</td>
<td>81 (7)(^k)</td>
</tr>
</tbody>
</table>

\(^{a–g}\) McNemar test.
\(^{h–k}\) Wilcoxon test.

Month 3 significantly higher than baseline: \(^{i}(P = 0.000), {i}(P = 0.000), {i}(P = 0.000), {i}(P = 0.000), {i}(P = 0.000), {i}(P = 0.000), {i}(P = 0.007).\)

No significant difference between Month 3 and baseline: \(^{i}(P = 0.142), {i}(P = 0.880), {i}(P = 0.280), {i}(P = 0.188)\), \(^{i}(P = 0.784).\)

Fig. 3 Use of CVD preventive medicines.
What is already known on the topic

Our earlier study demonstrated the feasibility of using resident health records to perform CVD risk assessment and identify people with a high risk of CVD based on the Asian Equation. Although the CVD-preventive drugs as recommended in this study were widely available in rural China, the uptake was very low: 35% of the high-risk subjects reported using any of those drugs, only 2% used aspirin, 0.8% used statin, 7% used a combination of any two or more of the above drugs. The effect of CVD-preventive drugs on reducing CVD risk was well established for the antihypertensive drugs, statins and aspirin, especially the low-dose combination of aspirin, statin and anti-antihypertensive. However, similar interventions have often been conducted under clinical trial conditions. Healthy lifestyles, such as improved diet, smoking cessation and increased exercise, had certain effects in reducing multiple CVD risk factors, even with sustaining effects. The interventions involved community-based education and management, and individually based interventions. Importance and strategies for adherence support have been raised for chronic disease control, though with limited empirical evidence. It is unknown whether a holistic CVD risk reduction approach based on drug therapies and lifestyle and adherence support is feasible and effective for the management of subjects with a high risk of CVD in the rural PHC.

What this study adds

This is a real-life exploratory study of a public health intervention in a rural PHC setting in China preceding the conduct of a cluster-based RCT. Our intervention has the strength of combining CVD-preventive drug prescriptions and lifestyle and adherence support to prevent CVD among high-risk subjects. Our intervention has a great potential to influence policy and practice as it is embedded within the existing implementation of the EPHS and has the consequence of capacity strengthening and quality improvement for PHC.

This study adds to the understanding of using risk approach to prevent CVD in PHC. It remains debatable whether a risk versus population approach should be more cost-effective to prevent CVD. However, prioritizing identification and treatment of those with high CVD risk fits with the busy routine clinical practices in China. Our approach has the potential to improve uptake of CVD-preventive medicine among the high-risk subjects in PHC. Unlike clinical trials, our drug prescription is pragmatic and individualized, closely integrated with the routine PHC practices. Family doctors provided detailed and repeated education to the patients. However, the lower uptake of low-dose combination suggests the multiple factors remaining tackling for effective intervention. The adherence support strategies, as introduced from TB and HIV control may have helped to improve adherence to the therapeutic and lifestyle interventions and medical appointments. Overall, the systematic risk reduction strategy may have contributed to the mild reduction of BPs.

Our study invokes the discussion of longer time feasibility of integrating preventive CVD care in the PHC. The PHC facilities have benefited from recent policy changes such as implementation of EPHS. The PHC system has additional strength in providing first-contact access, and long-term, patient-centered, comprehensive and coordinated care for chronic patients. However, the CVD-related conditions have traditionally been treated by higher level hospitals. Patient confidence in the PHC capacity may remain low. Innovative, tailored and repeated training is needed for PHC staff, with a view to improve their communication skills and medical knowledge (e.g. dealing with adverse events). On the patient side, lower health literacy and beliefs in traditional therapies still need tackling through continuous health education. However, the NCMS generally provides very limited coverage for outpatient care. The larger share of costs by the patients may limit their ability and desire to seek CVD preventive care in the PHC. The drug purchasing mechanism should ensure the most cost-effective drugs are available in the PHC. In this study, however, the financial burden is moderate. As another study indicated, the total costs of drugs per month would be RMB111 (US$17.3) in rural Zhejiang. Taking into account the NCMS contribution (30%), the financial burden would be 6–10% of the average personal monthly income (US$ 176–102).
Limitation of study
The nature of the exploratory study makes its generalizability limited. First, the relatively small sample size may have limited the power to detect impacts of socio-economic and demographic factors on the study outcomes such as uptake of low-dose combination drugs and smoking cessation. The discrepancy between the number of high-risk subjects screened from the health records and the research checkup may be due to the different instruments and quality control procedures used for the routine health checkups and our research checkup, and the fact that health records collected for this study were not the most updated. Secondly, no control site was adopted, though the before-and-after design is most useful in demonstrating the immediate impacts of short-term programs. The shorter duration has caused less threat for the internal validity since it received fewer external influences over time. Finally, perhaps due to the short duration, we did not detect significant changes in salt reduction and blood pressures. We did not use exercise and drinking as tracers for lifestyle changes mainly because of the measurement challenges: most of the rural residents worked in the fields to various extent even >60 (thus ‘confounding’ exercise measurement), while the local people drank various types of wines and alcohols. Report bias should exist despite enhanced training to the PHC staff to interview patients. However, this exploratory study has helped to refine the intervention and research procedures including these for the conduct of RCT.

Conclusion
A holistic CVD risk reduction approach showed preliminary effects in a rural PHC setting in Zhejiang, China. However, further understanding is needed regarding its long-term effectiveness and feasibility in rural PHC practices. Our cluster-based RCT would provide the highest level of evidence for the policy development of preventing CVD in the rural PHC of China and other countries with similar settings.

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