

## Health System Reform in China 3



# Emergence of chronic non-communicable diseases in China

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China has experienced an epidemiological transition shifting from the infectious to the chronic diseases in much shorter time than many other countries. The pace and spread of behavioural changes, including changing diets, decreased physical activity, high rates of male smoking, and other high risk behaviours, has accelerated to an unprecedented degree. As a result, the burden of chronic diseases, preventable morbidity and mortality, and associated health-care costs could now increase substantially. China already has 177 million adults with hypertension; furthermore, 303 million adults smoke, which is a third of the world's total number of smokers, and 530 million people in China are passively exposed to second-hand smoke. The prevalence of overweight people and obesity is increasing in Chinese adults and children, because of dietary changes and reduced physical activity. Emergence of chronic diseases presents special challenges for China's ongoing reform of health care, given the large numbers who require curative treatment and the narrow window of opportunity for timely prevention of disease.

### Introduction

Many profound changes began with the formation in 1950 of the People's Republic of China, and one of the most striking was a rapid improvement in disease prevention and control leading to marked increases in longevity.<sup>1</sup> The epidemiological transition, which occurred earlier and at a slower pace in many western nations was compressed into only a few decades in China, as the predominant cause of mortality shifted from the infectious diseases and perinatal conditions to chronic diseases and injuries. This shift in the contributing causes of mortality was achieved through health interventions such as increased vaccination coverage; better hygiene, sanitation and water quality; improved access to medical care; and advanced social and living standards such as universal education, higher incomes, and better nutrition and housing. Population age structure is also shifting due to fertility and mortality decline, thereby increasing the proportion of elderly people.<sup>2</sup>

In more recent decades, the momentum of China's epidemiological transition has continued unabated. Many of the known risk factors for chronic diseases have dramatically increased as societal change progresses. These behavioural elements include changing diets, levels of physical activity, tobacco consumption, and automobile use. These same behavioural shifts have been observed in many developed countries over the past 50 years, but they have accelerated at a historically unprecedented pace and scale in China, accompanying the rapid growth of the national economy over the past 30 years.

We will describe the changing patterns of mortality in China, focusing on recent data on prevalence of key behavioural risk factors. The likely effect of these behavioural changes on the health of Chinese people will exacerbate the enormous challenges that chronic diseases will present to efforts to reform the nation's health-care system.

### Definitions and data

We used national censuses in 1982,<sup>3</sup> 1990,<sup>4</sup> and 2000<sup>5</sup> to obtain population and mortality data from all households. The 1982 census (with a reference date of July 1, 1982) collected information on all deaths in the calendar year 1981; the 1990 census (with a reference date of July 1, 1990) collected death information in the calendar year 1989 and between January and June, 1990; the 2000 census (with a reference date of Nov 1, 2000) collected death information in the 12 months before the census, between November, 1999, and October, 2000.<sup>6</sup>

For analyses of causes of death, we used two surveys by the Chinese Ministry of Health, in 1973–75<sup>7</sup> and 2006,<sup>8</sup> and the national system of disease surveillance points in 1991–2000.<sup>9</sup> The 1973–75 death survey, which was also called the cancer epidemiology survey, covered 2392 counties or about 850 million people and included information from family members and medical records on causes of death by age and sex.<sup>7</sup> Causes of death were classified into infectious diseases, pneumonia, tuberculosis, cancer (including main cancers such as lung cancer and stomach cancer), cerebrocardiovascular diseases, chronic respiratory diseases, chronic bronchitis, hepatocirrhosis, other non-communicable disease, and injury. Causes of death were linked to standard International Classification of Diseases (ICD) according to the mapping table of ICD.<sup>10</sup> Data from the 1973–75 survey were reported by age groups and causes. China has a system, based on disease surveillance points in 145 locations throughout the country, selected by multiple-stratified random sampling, which covers a 1% sample of China's population. Between 1991 and 2000, this system recorded causes of death for 10 million people. This nationally representative sample reflected regional population distributions, urban and rural areas, age and sex, and eastern, middle, and western regions.<sup>11</sup> After new legislation in 1992,<sup>12</sup> a uniform certification procedure for cause of death is now in place for institutional deaths in China, based on the international format for cause of

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**Panel 1: Definitions****Hypertension**

Systolic blood pressure of 140 mm Hg or greater, diastolic blood pressure of 90 mm Hg or greater,<sup>19</sup> or both; or use of medicine to control blood pressure in the past 2 weeks.<sup>19</sup> All blood pressure values were based on actual measurements.<sup>20</sup>

**Obesity**

Body-mass index of 28 kg/m<sup>2</sup> or greater for adults aged 18 years and older.<sup>21</sup> WHO uses 30 kg/m<sup>2</sup> as the threshold, and a threshold of 27 kg/m<sup>2</sup> has been recommended for Asia.<sup>22,23</sup>

**Overweight**

Body-mass index of 24 kg/m<sup>2</sup> or greater for adults aged 18 years and older.<sup>21</sup> WHO uses 25 kg/m<sup>2</sup> as the threshold, and a threshold of 23 kg/m<sup>2</sup> has been recommended for Asia.<sup>22,23</sup>

**Ever-smoker**

A person who has smoked daily for at least 6 months during their lives.<sup>24</sup>

**Current smoker**

A person who, at the time of the survey, smoked a tobacco product.<sup>24</sup>

**Passive smoker**

A person who is exposed to smoke exhaled by a smoker for more than 15 min per day and more than once per week.<sup>24</sup>

death.<sup>10</sup> For deaths at home, causes of deaths are determined based on information provided by family members, with or without documentary medical evidence. Several studies have validated the causes of death reported by the system of disease surveillance points.<sup>13–17</sup> The reliability of the data for death causes at a population level is a key issue in China, where not all deaths occur in hospitals or health establishments. The studies show that for major causes at least, ascertainment of cause of death is reasonably reliable. Every 3 years under-reporting is estimated by a survey that covers 5% of the surveillance population, and mortality estimates are adjusted accordingly.<sup>18</sup> The data from disease surveillance points included more than half a million deaths with causes classified on ICD-9.

The disease surveillance points system was expanded in 2001, to cover 71·4 million people. Each point of the system has been expanded to a whole county, or district, to cover 300 000–700 000 people. A national death survey in 2006 checked the quality of reporting data of the expanded system by re-collecting causes of death during 2004–05. 868 484 cases of death from household inquiry were recorded. So-called verbal autopsies were used to characterise deaths without hospital diagnosis. About 6·44% of deaths were diagnosed by these instruments. Causes of death were classified according to the ICD-10.<sup>10</sup> Data from the disease surveillance points system in 2004–05 were verified by the 2006 survey.

Mortality patterns have been described in three groups: communicable and maternal and perinatal conditions; non-communicable chronic diseases; and injuries. The chronic diseases include cancer, cardiovascular disease, diabetes mellitus, arthritis, cerebrovascular disease, and other conditions, following standard international classification systems.<sup>10</sup> Since causes of death were not classified according to ICD in the 1973–75 survey, we combined infectious diseases, tuberculosis, and pneumonia into communicable diseases. We compared data for causes of death in the 1991–2000 disease surveillance points survey and the 2006 survey based on the same standard. Trends for individual causes of death were analysed with disease surveillance points data, since they were collected with the same methods in the same population. The same codes for causes of death reported from 1991 to 2000 in the disease surveillance points data were used for the 2006 death survey, for purposes of comparison. To verify the increasing and decreasing trend of these diseases, we calculated age-standardised death rates in 2005 based on the population structure from China's 2000 census.<sup>5</sup>

Panel 1 summarises definitions for hypertension, smoking, obesity, and adults who are overweight. Risk factor data were sourced from three types of national surveys. Data on hypertension were obtained from national surveys in 1991 and 2002.<sup>20</sup> Data on overweight people, obesity, and dietary intake were obtained from national nutrition surveys conducted in 1992 and 2002.<sup>20</sup> Data on tobacco use are from the national surveys on tobacco use in 1984<sup>25,26</sup> and 1996,<sup>27,28</sup> and from a national survey on risk factors for chronic disease in 2002.<sup>29</sup>

**Mortality pattern changed**

Figure 1 shows life expectancy in China from 1945–49 to 1999–2000.<sup>6,30</sup> Life expectancy increased after 1950, and especially quickly before 1975, because of successful control of infectious diseases and maternal and prenatal conditions. Since 1990, life expectancy has plateaued, in association with the emergence of chronic diseases. Life expectancy at birth increased from less than 50 years to nearly 70 years during the 40 years between 1950 and 1990. Between 1990 and 2000, however, life expectancy increased by only 2 years, from 70 to 72 years.

Mortality analysis has shown a parallel transition in the major causes of death in the past 30 years (figure 2). Whereas in 1973, communicable diseases and maternal and perinatal conditions accounted for 27·8% of deaths, that proportion had fallen to 5·2% by 2005. The converse trend was observed for chronic diseases: cerebro-cardiovascular diseases, chronic obstructive pulmonary disease, and cancers increased as a proportion of all deaths, from 41·7% in 1973 to 74·1% in 2005.

Surveillance data from 1991 to 2000 show the pace of these changes.<sup>9</sup> The age-standardised death rate fell by 13% over this period. Age-standardised death rates for 17 individual causes (infectious diseases; tuberculosis;

pneumonia; maternal and perinatal disorders; viral hepatitis; rheumatic heart diseases; cholelithiasis; hypertension; intentional self-harm; accidents caused by fire and flames; accidental drowning and submersion; accidental falls; accidental poisoning; congenital malformations, deformations, and chromosomal abnormalities; chronic obstructive pulmonary disease; oesophageal cancer; and liver diseases) decreased by more than 10%. Overall, the age-standardised rates of death for these 17 causes decreased by 91 people per 100 000 between 1991 and 2000. By contrast, the age-standardised rates of mortality for seven other causes of death increased by more than 10%. These causes were stroke, coronary heart disease, diabetes, lung cancer, liver cancer, breast cancer, and traffic accidents. The age-standardised rates of death from these causes increased by 40 people per 100 000 (from 172 per 100 000 in 1991 to 212 per 100 000 in 2000). These seven causes accounted for 38.5% of deaths in 2000. Figure 3 shows four causes of death that increased over this period (lung cancer, cerebrovascular disease, coronary heart disease, and diabetes) and three causes that decreased (infectious diseases, pneumonia, and perinatal disorders).

In China, patterns in causes of death have varied between urban and rural areas and between populations in the eastern, middle, and western regions of rural areas (table 1). Rural areas (especially in western regions) have had higher mortality from communicable diseases, maternal and perinatal conditions, chronic obstructive pulmonary diseases, and injuries. By contrast, urban areas have had higher death rates from cardiovascular heart disease and cerebrovascular diseases. The 2006 mortality survey showed that age-standardised death rates from lung cancer, breast cancer, and leukaemia were higher in urban than in rural areas, but that oesophageal cancer and cervical cancer were higher in rural than in urban areas.<sup>8</sup> Urban and rural liver cancer mortality rates were similar.

### Behavioural risk factors

Two major forces have been responsible for the emergence of chronic diseases in China. The first has been the very rapid transition of China's population from a youthful to an ageing population as life expectancy has increased. This so-called greying of China's population has increased causes of death associated with elderly populations. Birth rates have plummeted, and China's one-child family policy has been a strong driver of population ageing.<sup>31</sup> Whereas 7.6% of the population were aged 60 years and older in 1982,<sup>3</sup> this proportion had grown to 10.5%, or 129 million, by 2000.<sup>5</sup> The World Bank has projected that more than 400 million Chinese people could be older than 60 years by 2050.<sup>32</sup>

However, the substantial increases in age-standardised rates of death from the major chronic diseases suggest that an even more powerful force has driven the emergence of chronic diseases. This force is the rapid

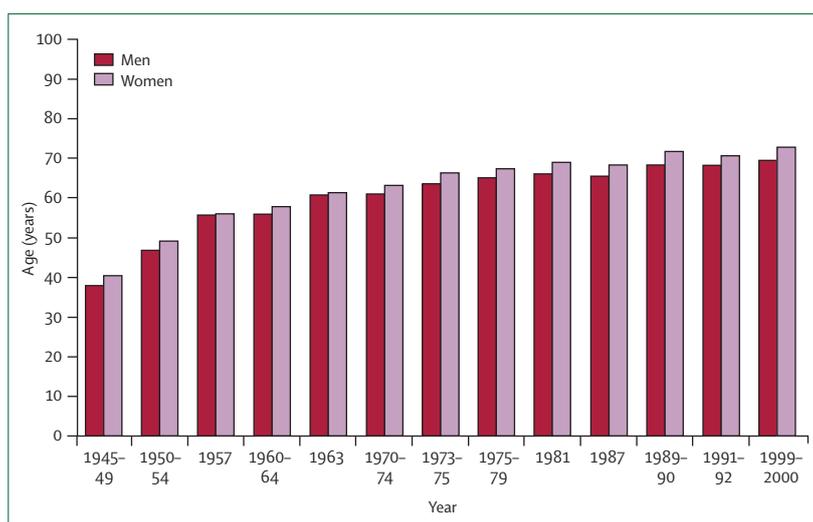


Figure 1: Life expectancy at birth in some years in China

Data are from references 6 and 30.

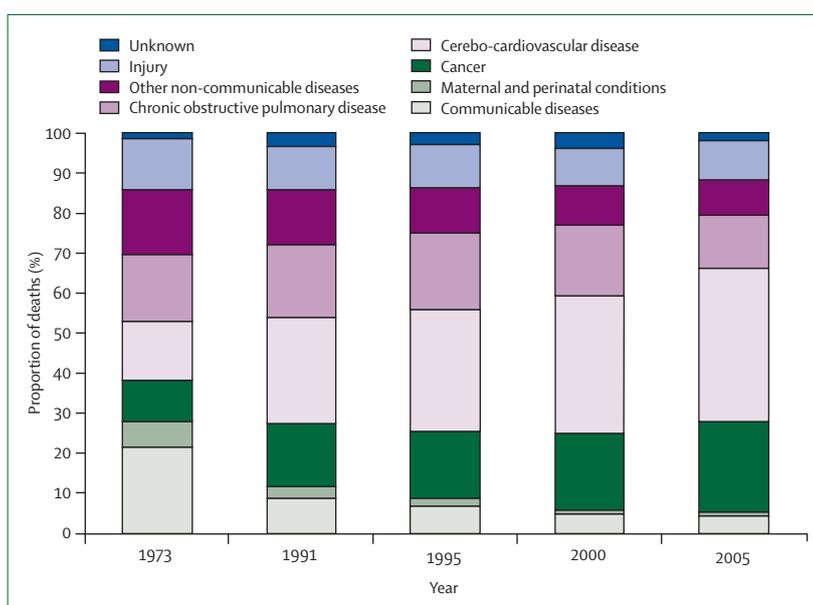


Figure 2: Distribution of causes of death between 1973 and 2005

Data are from references 7-9.

increase in high-risk behaviours. In China, the sheer scale of hypertension, increase in dietary fats, reduced physical activity, smoking, and other high-risk behaviours is noteworthy (table 2). Some of these risky behaviours demonstrate distinctive Chinese characteristics.

### Dietary changes

Along with the substantial rise in people's income during the rapid economic development of China over the past 20 years, the food supply and variety of food products has increased, with accompanying changes in dietary patterns. The intake of cereal decreased substantially over this period, whereas intakes of meat

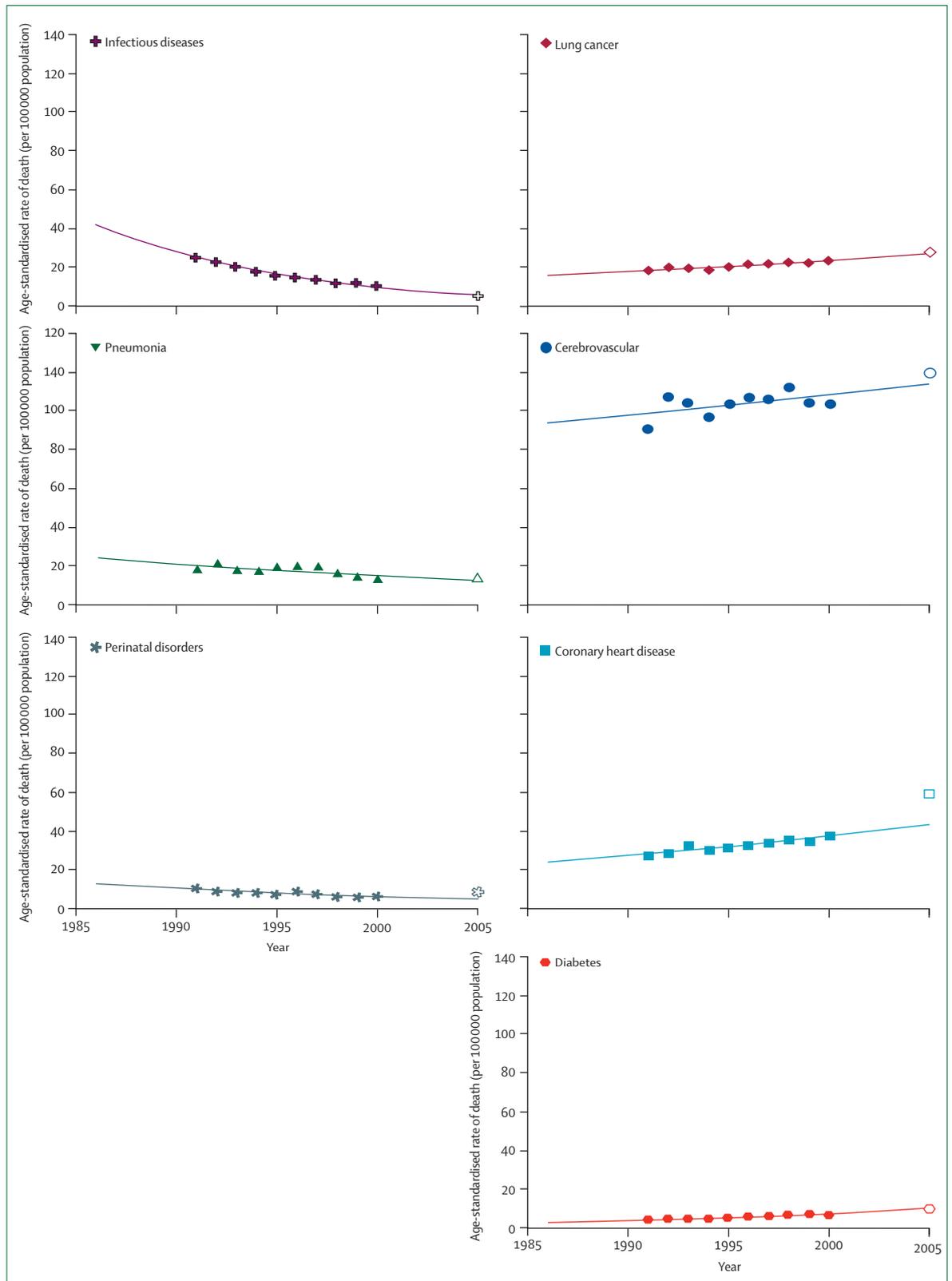


Figure 3: Changing age-standardised cause of selected death rates 1991-2000  
Data are from reference 9.

and edible oil increased. Fat intake increased from 68·3 g per day in 1982 to 85·6 g per day for urban Chinese, and from 39·6 g to 72·6 g for rural Chinese.<sup>20</sup> In both urban and rural areas, cereals decreased as a proportion of the diet, whereas fats increased. In 1982, cereals contributed 74·6% of energy intake in rural areas and fats constituted 25% of energy intake in urban areas.<sup>33</sup> By 2002, cereals contributed 61·5% of energy intake in rural areas, and fats constituted 35% of energy intake in urban areas.<sup>20</sup>

### Hypertension

The prevalence of hypertension in China has been rising rapidly during the last 30 years. In 2002, nearly 18% of Chinese adults aged 15 years and older had hypertension, corresponding to 177 million people.<sup>34</sup> No other country has a larger group of people with hypertension. One presumed causative factor is high salt intake in both urban and rural Chinese diets. In 2002, the average daily salt intake for a reference man (aged 18 years with light level of physical activity) was 12 g per day,<sup>20</sup> which is approximately twice that recommended by Chinese dietary guidelines.<sup>35</sup> In some rural areas, average salt intake was as high as 14·7 g.<sup>20</sup>

Despite known health benefits, control of hypertension in China is far from optimum. According to the national nutrition survey of 2002, only 30% of adults with hypertension are aware of their condition.<sup>20</sup> Of those 30%, only 6% manage their hypertension effectively, 6% are without treatment, and 19% treated their hypertension without gaining adequate control.<sup>34</sup>

### Overweight people and obesity

By the WHO definitions, 18·9% of Chinese adults aged 18 years and older were overweight in 2002, and 2·9% were obese. However, by definitions used elsewhere in Asia, prevalences were higher, with 31% overweight people and 12·1% obese people in 2002.<sup>22,23</sup> The Chinese Ministry of Health has recommended that people with a body-mass index of 24 kg/m<sup>2</sup> or more should be considered overweight, and that those with an index of 28 kg/m<sup>2</sup> or more should be considered obese. Based on these thresholds, 22·8% of Chinese people were overweight in 2002, and 7·1% were obese. The proportion of overweight adults increased by 39% between 1992 and 2002, based on the Chinese threshold, whereas the proportion of obese people increased by 97%. In large cities, 13% of children and adolescents aged 7–17 years were overweight, and 8% were obese.<sup>20,36</sup>

The average daily calorie intake of both urban and rural Chinese has changed little over the past two decades. Calorie intakes of 2491–2250 kcal per day were reported in 1982, 1992, and 2002.<sup>20</sup> This suggests that the increases of overweight people and obesity have been mainly caused by reduced physical activity. 49% of Chinese people reported that their physical activities decreased over a 10-year period.<sup>37</sup> The average time that Chinese

	Urban	Rural			
		Total	Eastern regions	Middle regions	Western regions
Communicable diseases	16	27	18	23	42
Maternal and perinatal conditions	5	7	6	7	10
Cancer	127	125	131	133	107
Cerebro-cardiovascular causes	193	210	195	254	180
Chronic obstructive pulmonary disease	52	81	65	80	103
Other non-communicable diseases	49	48	43	42	61
Injury	44	66	63	65	72
Unknown	13	8	10	7	6
Total	499	572	531	610	581

Data are deaths per 100 000 population. Data are from reference 8.

**Table 1: Age-standardised rates of death from different causes (2004–05)**

	Age-standardised prevalence rate	Average increase, compared with most recent survey	Estimated population at risk*
People with hypertension†	17·7%	2·67%‡	177 000 000
Overweight people	17·6%	3·23%§	218 000 000
Obese people	5·6%	5·43%§	68 000 000
Current smokers†	28·2%	–2·91%	303 000 000
Male current smokers†	53·2%	–3·01%¶	290 000 000
Female current smokers†	2·2%	–8·26%¶	13 000 000
Passive smokers†	52·2%	–0·49%¶	530 000 000

Data for hypertension, overweight, and obesity are from reference 20; data for smoking are from references 27 and 29. \*Estimated population at risk extrapolates prevalence to entire population in these subgroups. †Data for people older than 15 years. ‡Compared with 1991 national survey on hypertension.<sup>20</sup> §Compared with 1992 national survey on nutrition and health.<sup>20</sup> ¶Compared with results of 1996 national survey.<sup>27,29</sup>

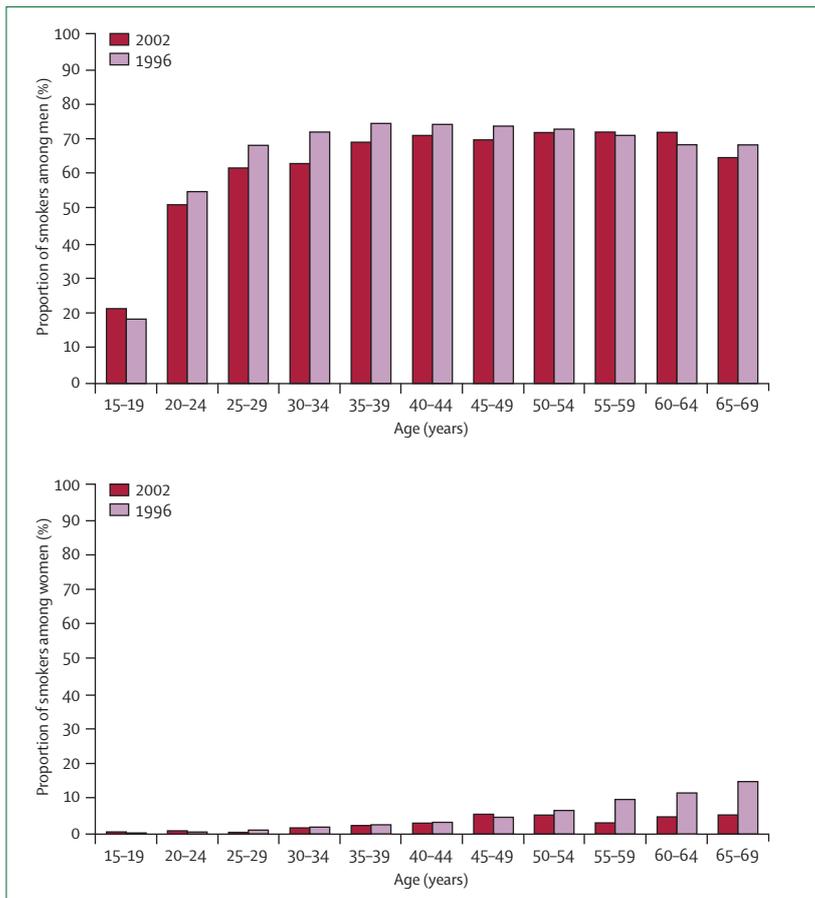
**Table 2: Age-standardised prevalence and number of Chinese with hypertension and obesity, and those who are overweight and smoke (2002)**

adults spent watching television every day was 2·1 h, and risks for gaining weight have been associated with time spent watching television.<sup>20</sup> Only 15% of urban Chinese adults exercised regularly in 2002.<sup>20</sup>

### Tobacco use

China is the largest tobacco grower and consumer in the world.<sup>28</sup> One in every three smokers in the world is a Chinese man.<sup>38,39</sup> Domestic tobacco production has steadily increased from 80 billion cigarettes in 1949, to 256 billion in 1968, 651 billion in 1979, 1630 billion in 1990,<sup>40</sup> and 1723 billion in 2002. Consumption of cigarettes increased to 2022 billion in 2006,<sup>41,42</sup> 17·4% higher than in 2002. 99·2% of domestically produced cigarettes are consumed in China and only 0·8% are exported.<sup>42</sup> Average consumption for Chinese men has increased from 13 cigarettes per day in 1984 to 15 cigarettes per day in 2002.<sup>42</sup>

Figure 4 show that in 1996 and 2002, more than 60% of men older than 25 years were smokers. Rates of smoking



**Figure 4: Comparison of smoking rates by age and sex in 1996 and 2002**  
Data are from references 27 and 29.

were much lower for women. Smoking was most prevalent in elderly women in 1996, at 15% in those over 65 years, but had reduced by 2002. However, the large proportion of male smokers in China has been high and stable for the past two decades—with smoking prevalence of 61% in 1984,<sup>25</sup> 63% in 1996,<sup>27</sup> and 57% in 2002.<sup>9</sup> Cultural and social factors have discouraged tobacco use in Chinese women.<sup>43</sup> The average age of initiation to smoking fell to 18 years for men in 2002, compared with 22 years in 1984, and women were also introduced at a younger age (20 years, compared with 25 years).<sup>25,29</sup> Passive exposure to tobacco smoke affects 52.2% of the Chinese population, and did not change between 1996 and 2002. 82% of passive smokers reported exposure at home; 35% at their workplace; and 67% in public places.<sup>9</sup>

### Responding to chronic disease

These data show that China has completed the epidemiological transition from a predominance of infectious diseases and maternal and perinatal conditions to chronic diseases and injury. Whereas non-communicable diseases constituted 58.2% of all deaths in 1973–75, the proportion had increased to 73.8% in

1991. By 2000, 82.9% of all deaths were due to non-communicable diseases, corresponding to the loss of about 70% of all disability-adjusted life-years.<sup>44</sup>

Unfortunately, the prevalence and burden of chronic diseases will probably continue to grow. China's ageing population structure will inevitably produce higher ratios of the chronic diseases that are commonly seen in older age groups. But rises in the rates of death from stroke, coronary heart diseases, diabetes, lung cancer, liver cancer, and breast cancer also show the importance of changing behavioural risk factors—high dietary intake of salt, increasing intake of fats, and decreasing intake of cereal and reduced physical activities. The rate of these changes in high-risk behaviour and the early age at which they begin, are of especial concern.

The direct and indirect economic costs of chronic diseases are already substantial, and are likely to grow. Direct costs include expenditures for admissions to hospital; medical costs; costs of prevention; and care-related travel, nursing, and family support. Indirect costs come from lower productivity, sick leave, loss of productive workers from early retirement, premature deaths, and time lost by family members. These costs are heavy and can cause impoverishment. Surveys on use of health care in 2003 showed that the average medical fee for treatment of inpatients with hypertension, diabetes, coronary heart diseases, stroke, and cancer was 4000–10000 Chinese Renminbi (7 Renminbi=US\$1),<sup>45</sup> in comparison with the average urban income of 9422 Renminbi per year, and 2936 Renminbi for a rural family.<sup>46</sup> Inpatient treatment for common chronic diseases, therefore, could cost over half of annual income for urban residents and up to three times the annual income of rural residents. Surveys in 2003 showed that the direct cost of admissions to hospital for patients with ischaemic stroke was 10.7 billion Renminbi. Total expenditure on ischaemic stroke was 19.8 billion Renminbi, which accounted for 3.0% of the entire national health expenditure.<sup>47</sup>

Both the health burden of chronic diseases and their economic burden exert pressure for China's recently launched health-care reforms; these burdens also prioritise certain aspects of these reforms. The demand for health-care services for chronic diseases can drive use of high-cost advanced technologies in tertiary facilities. Risk pooling of health-care financing to mitigate the effects of out-of-pocket payments for treatment of chronic diseases should be a priority in terms of public need and health equity. Tighter integration of primary, secondary, and tertiary care services should also be a priority, to channel treatment of chronic diseases to the most cost-efficient levels of the health-care system. Reform efforts must avoid bypassing primary facilities for more expensive tertiary facilities. Care of chronic diseases will profoundly challenge China's home-based system for rehabilitation. Family-care systems are likely to become more fragile, because of the increasingly elderly population, one-child families, dual roles of Chinese women as both workers

and carers, and large-scale rural-to-urban migration in which young people have moved into the cities and left elderly people behind in rural areas.

Prevention first is the best, most important, and most appropriate dictum and relevant strategy for China. Even a modest reduction of behavioural risk factors could generate substantial health benefits. If the increasing mortality and morbidity due to chronic diseases are to be averted, prevention strategies (such as reduction of tobacco use, exposure to second-hand smoke, dietary intakes of salt and fat, and promotion of increased physical activity) will need to be prioritised. All these strategies will need to be supported by public policies. These policies can no longer be isolated from policies in other sectors such as employment, income maintenance, social welfare, housing, education, and the mass media, including television.

To undertake these prevention activities, China's health prevention and disease control systems will need to be strengthened. Institutional reforms will be needed to realign established strategies for control of infectious diseases and combat the emergence of the chronic diseases that now cause a high proportion of deaths. Treatment of individuals in the health sector is another appropriate prevention strategy for chronic diseases. Although the focus of the medical community on service to high-risk patients benefits individuals, effective long-term prevention will also need a much wider, multisectoral commitment. Social action is one of the most important strategies to reduce non-communicable diseases. Reducing non-communicable disease is the key intervention for reduction of poverty, and the reduction of social inequalities and inequities in health.<sup>48</sup> Social actions need to include mobilisation of allied sectors, including transport (to address the growth in automobile use and less friendly environments for cycling and pedestrians); education (to enhance comprehensive school-based health education and promotion); fiscal policy (to increase tobacco taxes); regulatory action (to ensure food safety and content, and prohibit smoking in public places); and urban design (to provide parks, green spaces, and paths for bicycles and walkers).

Addressing major risk factors for chronic diseases should be given the highest priority. Prevention should focus on combating risk factors in an integrated manner at the level of family and community, to tackle deeply entrenched social and cultural factors.<sup>49</sup> The Ministry of Health must develop its skills and capabilities more broadly than the biomedical sciences. For example, hypertension and tobacco can be targeted as behavioural health priorities. Reduction of salt intake should become a national campaign, including dietary guidelines and food labelling. Blood pressure measurement should be measured at all health encounters, and non-traditional opportunities for measurement (such as in shopping areas and recreational sites) should be identified.

### Panel 2: Stroke prevention

Major national programmes to promote healthy behaviour and prevent the emergence of chronic diseases have not yet taken hold in China. Over recent years, a series of pilot programmes have demonstrated that promising results are possible if interventions are pursued vigorously. Examples are two stroke prevention programmes:

- Prevention in the community<sup>51</sup>  
Three cities—Beijing, Shanghai, and Changsha—piloted a community-based intervention in 1992 and 2000, consisting of blood-pressure screening, treatment for hypertension, and disseminated health education. Two cities (with almost 140 000 participants) introduced the intervention, and one was used as a control site (with 153 805 participants). Results after 9 years showed that strokes fell by 51.5% in men and by 52.7% in women, compared with 7.3% and 15.7% respectively in the control city.
- Prevention at the workplace<sup>34</sup>  
Factories owned by the Capital Iron and Steel Company were assigned to intervention and comparison groups. The intervention, for cerebrovascular disease, involved blood-pressure screening, treatment of hypertension, restriction of salt intake, and programmes to lose weight. After 8 years, the average blood pressure and proportion of people with hypertension were lower in the intervention group (2.5 mm Hg) than in the comparison group (2.2 mm Hg).

The Ottawa Charter for health promotion has pointed out that one important strategic action for health promotion is to build healthy public policy, which is the responsibility of government.<sup>50</sup> For example, China has adopted the Framework Convention of Tobacco Control, but for effective implementation this needs to be translated into policy, including increased taxes and prices for cigarettes, protection of non-smokers from second-hand smoke, prohibition of advertisements for cigarette products, regulation of the contents of tobacco products, and information and disclosures in the packaging and labelling of tobacco products.

China has had some successes in the control of chronic diseases in pilot programmes, for example stroke prevention (panel 2). A pilot project to target smoking in seven Chinese cities reduced the prevalence of smoking in men from 70% to 55%, increased cessation of smoking from 15% to 22%, and decreased exposure to second-hand smoke from 1996 to 2002.<sup>34</sup> Replication of these small-scale pilot interventions at larger scale is feasible. Lessons from other countries could also be applied in China, such as a population-based multifocal intervention in Finland, which reduced mortality from cardiovascular heart disease.<sup>52</sup> Continued surveillance of the levels and pattern of risk factors will be fundamental to assessment of activities to prevent

and control non-communicable diseases. Chinese Centre for Disease Control should develop more robust systems for surveillance and data analysis, and provide more evidence-based guidelines for nationwide control of non-communicable diseases.

Just as China was able to control infectious diseases within a shorter time than other countries, it has the opportunity today to reduce the time over which chronic diseases take a high health and economic toll in the country. China's early and substantial success in control of infectious diseases was achieved by prevention strategies; prevention will also be an urgent strategy that can be implemented both within China's public-health structure and by practitioners of clinical care. Prevention and control of chronic diseases is a large and complex task, but no more so than many of the challenges that have confronted China in its long history, and especially in its last 50 years. China can build on its health, economic, educational, and development successes and address the challenge of chronic diseases and their risk factors. In so doing, it might provide insights and approaches for other nations to adopt in improving the health of their populations.

#### Contributors

GHY, LCC, and JPK participated in the conception, writing, and discussion of the paper. LZK and WHZ took part in the writing and discussion of the article. XW and YZ participated in data analysis and discussion of the article. All authors have seen and approved the final version.

#### Conflict of interest statement

We declare that we have no conflict of interest.

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#### References

- Tang S, Meng Q, Chen LC, Bekedam H, Whitehead M. Tackling the challenges to health equity in China. *Lancet* 2008; published online October 20. DOI:10.1016/S0140-6736(08)61364-1.
- UN Department of Economic and Social Affairs. World population prospects: the 2006 revision. New York, NY, USA: Population Division, UN Secretariat, 2006. <http://esa.un.org/unpp> (accessed August 11, 2008).
- State Statistical Bureau, People's Republic of China. 1982 population census of China. Beijing, China: Population Census Office, State Council and Department of Population Statistics, 1985.
- Population Census Office, State Council and Department of Population Statistics, State Statistical Bureau. Tabulation on the 1990 population census of the People's Republic of China. Beijing, China: China Statistical Publishing House, 1993.
- Population Census Office, State Council and Department of Population Statistics, State Statistical Bureau. Tabulation on the 2000 population census of the People's Republic of China. Beijing, China: China Statistics Press, 2002.
- Banister J, Hill K. Mortality in China 1964–2000. *Population Studies* 2004; **58**: 55–75.
- Cancer Preventive and Control Office, Ministry of Health. The study on cancer death survey in Chinese population. Beijing, China: People's Health Press, 1979.
- China Internet Information Centre. Issues on the promulgation of the third survey on causes of death. Beijing, China: Ministry of Health, April, 2008. [http://www.china.com.cn/zhibo/2008-04/29/content\\_15028586.htm?show=t](http://www.china.com.cn/zhibo/2008-04/29/content_15028586.htm?show=t) (accessed July 15, 2008).
- Yang GH. Deaths and their risk factors among Chinese Population. Beijing, China: Union Medical University Press of China, 2005.
- WHO. International statistical classification of diseases and health related problems. 10th revision. Geneva, Switzerland: World Health Organization, 1993: 30–65.
- Yang GH, Zheng G, Zheng XW, et al. Selection of the second stage of DSP system and its representative. *J Chin Epidemiol* 1992; **13**: 79–81.
- Ministry of Health, Ministry of Public Security, Ministry of Civil Administration. Medical certification of death and strengthening vital registration of death causes. Beijing, China: Health Statistics Publication, 1992.
- Rao C, Lopez AD, Yang GH, Begg S, Ma JM. Evaluating national cause-of-death statistics: principles and application to the case of China. *Bull World Health Organ* 2005; **83**: 618–25.
- Rao C, Yang GH, Hu JP, Ma JM, Wan X, Lopez AD. Validation of cause-of-death statistics in urban China. *Int J Epidemiol* 2007; **36**: 642–51.
- Wang LJ, Yang GH, Ma JM, et al. Evaluation of the quality of cause of death statistics in rural China using verbal autopsies. *J Epidemiol Commun Health* 2007; **61**: 519–26.
- Yang GH, Rao C, Ma JM, et al. Validation of verbal autopsy procedures for adult deaths in China. *Int J Epidemiol* 2006; **35**: 741–48.
- Setel PW, Rao C, Hemed Y, et al. Core verbal autopsy procedures with comparative validation results from two countries. *PLoS Med* 2006; **3**: 1282–91.
- Ministry of Health, Chinese Academy of Prevention Medicine. A series of reports on Chinese disease surveillance (6): 1995 annual report on Chinese disease surveillance. Beijing, China: People's Medical Publishing House, 1997.
- Committee for revision of the Chinese guidelines for prevention and treatment of patients with hypertension. Chinese hypertension guidelines, 2005. Beijing, China: People's Medical Publishing House, 2006.
- Wang LD. Comprehensive report, Chinese nutrition and health survey in 2002. Beijing, China: People's Medical Publishing House, 2005.
- Chen CM, Lu FC; Department of Disease Control, Ministry of Health. Guidelines for prevention and control of overweight and obesity in Chinese adults. *Biomed Environ Sci* 2004; **17** (suppl 1): 1–36.
- WHO. Obesity Preventing and Managing. The Global Epidemic-Report of a WHO Consultation on Obesity. Geneva: World Health Organization, 1997.
- Choo V. WHO reassesses appropriate body-mass index for Asian population. *Lancet* 2002; **360**: 235.
- WHO. Guidelines for the conduct of tobacco smoking surveys for the general population (Document WHO/SMO/83.4). Geneva, Switzerland: World Health Organization, 1983.
- Committee of the National Patriotic Health Campaign, Ministry of Health. 1984 national prevalence survey of smoking pattern. Beijing, China: People's Medical Publishing House, 1987.
- Weng XZ, Hong ZG, Chen DY. Smoking prevalence in Chinese aged 15 and above. *Chin Med J (Engl)* 1987; **100**: 886–92.
- Chinese Academy of Preventive Medicine. Smoking and health in China -1996 national prevalence survey of smoking pattern. Beijing, China: China Science and Technology press; 1997.
- Yang GH, Fan LX, Tan J, et al. Smoking in China: findings of the 1996 national prevalence survey. *JAMA* 1999; **282**: 1247–53.
- Yang GH, Ma JM, Liu N, Zhou LN. Smoking and passive smoking in Chinese, 2002. *Chin J Epidemiol* 2005; **26**: 77–83.
- Huang RQ, Liu Y. Mortality data of China population. Beijing, China: China Population Press, 1995.
- Li JX. Fertility policy and population ageing in China. *Pop Res* 2000; **24**: 9–15.
- International Institute for Applied Systems Analysis. China's population by age and sex, 1950–2050. [http://www.iiasa.ac.at/Research/LUC/ChinaFood/data/anim/pop\\_ani.htm](http://www.iiasa.ac.at/Research/LUC/ChinaFood/data/anim/pop_ani.htm) (accessed on July 7, 2008).
- Ge KY. Changes of dietary pattern of Chinese population. *J Hygiene Res* 1996; **25** (suppl 29): 54–56.
- Department of Disease Control and Prevention, Ministry of Health. Report on chronic diseases in China. Beijing, China: Chinese Centre for Disease Control and Prevention, 2006.

- 35 Chinese Nutrition Society. Chinese dietary guidelines. Lhasa: Tibet People Publishing House, 2008.
- 36 Wu YF, Ma GS, Hu YH, et al. The current prevalence status of body overweight and obesity in China: data from the China national nutrition and health survey. *Chin J Prev Med* 2005; **39**: 316–20.
- 37 Xie GQ, Mai JZ, Zhao LC, et al. Physical activity status of working time and its change over a ten-year period in Beijing and Guangzhou populations. *J Hygiene Res* 2008; **37**: 33–36.
- 38 WHO. Report on the Global Tobacco Epidemic, 2008: The MPOWER package. Geneva: World Health Organization, 2008.
- 39 Ministry of Health. China tobacco control report, 2007. Beijing, China. <http://www.wpro.who.int/NR/rdonlyres/C5A0B72E-5041-469D-BC92-654F4DA38348/0/2007ChinaTobaccoControlReportChi.pdf> (accessed Sept 4, 2008).
- 40 Hua XL, ed. The China tobacco history. Beijing, China: China Press, 2006.
- 41 Huang XQ. Tobacco Economic in 2007. *China Tobacco* 2008; **3**: 59.
- 42 Periodic report of implementing FCTC. Beijing, China, 2007. [http://www.who.int/fctc/reporting/china\\_report.pdf](http://www.who.int/fctc/reporting/china_report.pdf) (accessed Sept 4, 2008).
- 43 Yang GH. The epidemic of tobacco use in China. In: Boyle P, Gray N, Henningfield J, Seffrin J, Zatonski W, eds. Tobacco—science, policy and public health. New York, NY, USA: Oxford University Press, 2004: 215–26.
- 44 Mathers CD, Lopez AD, Murray CJL. The burden of disease and mortality by condition: data, methods and results for 2001. In: Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL, eds. Global burden of disease and risk factors. New York, USA: Oxford University Press, 2006: 45–240.
- 45 Center for Health Statistics and information, Ministry of Health. An analysis report of national health services survey in 2003. Beijing, China: Chinese Academy Science & Peking Union Medical College Press, 2004.
- 46 Ministry of Health. Annual China health yearbook. Beijing, China: Chinese Academy Science & Peking Union Medical College Press, 2005.
- 47 Hu SL, Gong XG. Economic burden of ischemic stroke in China. *Chin Health Econom* 2003; **22**: 18–20.
- 48 WHO. Preventing chronic diseases: a vital investment. Geneva, Switzerland: World Health Organization, 2002. [http://www.who.int/chp/chronic\\_disease\\_reports/en](http://www.who.int/chp/chronic_disease_reports/en) (accessed Sept 4, 2008).
- 49 WHO. The world health report 2002. Reducing the risk, promoting healthy life. Geneva, Switzerland: World Health Organization, 2002. [http://2002/WHR\\_2002.pdf](http://2002/WHR_2002.pdf) (accessed Sept 4, 2008).
- 50 WHO. The Ottawa charter for health promotion. First International Conference on Health Promotion, Ottawa, Nov 21. Geneva: World Health Organization, 1986. <https://www.who.int/healthpromotion/conferences/previous/ottawa/en> (accessed Sept 4, 2008).
- 51 Wang WZ, Wu SP, Hong Z, et al. The change in incidence of stroke after a community-based intervention for nine years in three cities of China. *Chin J Geriatr Heart Brain Vessel Dis* 2002; **4**: 30–33.
- 52 Puska P. Comprehensive cardiovascular community control programmes in Europe. EURO Reports and Studies, No. 106. Copenhagen, Denmark: WHO Regional Office for Europe, 1988.