Changes in cardiovascular risk factors in different socioeconomic groups: seven year trends in a Chinese urban population

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Abstract

Study objective—To analyse trends in socioeconomic differences in cardiovascular disease risk factors among an urban Chinese population using educational attainment as the socioeconomic indicator.

Design—Population surveys with randomly selected independent samples were carried out in 1989 and in 1996. Educational attainment, blood pressure, body mass index, cigarette smoking and lack of leisure time physical activity were determined.

Setting—Urban areas of the city of Tianjin, China.

Participants—A total of 14 275 respondents aged 25–64 years.

Main results—Diastolic blood pressure increased and the proportion of people without leisure time physical activity decreased in both sexes during the study period. The prevalence of smoking and the number of cigarettes smoked daily increased significantly among men. Smoking decreased in the least educated men and increased in those who had studied at least to college level. Body mass index decreased across all educational strata in women, but blood pressure increased in women with at least college level education.

Conclusions—These data reveal a different picture in trends in the association of education and cardiovascular risk factors from those depicted in developed countries. This highlights the need for an effective intervention programme in the study population.

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There is abundant epidemiological evidence that socioeconomic status (SES) is inversely and consistently associated with cardiovascular disease (CVD) morbidity, mortality and levels of CVD risk factors in developed countries. Over time, the differences in the occurrence of CVD and the level of CVD risk factors between higher and lower socioeconomic groups have even become accentuated, though total CVD mortality is drastically falling in the affluent societies.

CVD is emerging as a major cause of death in developing countries. The association of SES and CVD in developing nations is not as consistent as those observed in developed countries. Some studies have indicated that SES is inversely associated with the occurrence of CVD and the level of CVD risk factors, whereas there are studies revealing an opposite trend.

China is the largest developing country in the world, CVD has become the major cause of death especially in urban areas. Two studies indicated an inverse association of SES and CVD risk factors in urban populations of China. To our knowledge, there has been no previous study reporting the trends in socioeconomic differences in CVD risk factors in the Chinese population. The purpose of this paper was to analyse trends in educational differences in CVD risk factors in the urban population of Tianjin, China between 1989 and 1996.

Methods

The city of Tianjin, with a population of nine and a half million, is the third largest city in China. Four million of the population lives in six urban districts. Mortality from heart diseases and stroke accounted for 51–56% of all deaths in the mid-1980s. The Tianjin Project was started in 1984 to find a way for preventing and controlling CVD in China. The baseline survey for a community-based intervention programme was conducted in 1989. A five year follow up survey was carried out in 1996. For both surveys, independent random samples were drawn using two stage sampling. Firstly, altogether eight communities in 1989 and 14 communities in 1996 were drawn randomly with at least one community from each of the six urban districts. In the second stage, samples stratified by gender, 10 year age group and community were taken from the local population registers. Altogether 19 300 people aged 15–69 years were examined with overall participation rates of 92–100%. In all, there were 14 046 participants in 1989 and 4000 participates in 1996. This study was restricted to those respondents aged 25–64 years (table 1).

Self reported education level was divided into three categories: 0–6 years (less than elementary school studies), 7–12 years (middle to high school studies) and 13 years or more.
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Table 2 Distributions of educational attainment in people aged 25–64 years by sex and study year in Tianjin, China, 1989 and 1996

<table>
<thead>
<tr>
<th>Years of education*</th>
<th>1989 Number (%)</th>
<th>1996 Number (%)</th>
<th>1989 Number (%)</th>
<th>1996 Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–5</td>
<td>1172 (21)</td>
<td>157 (11)</td>
<td>2158 (38)</td>
<td>269 (19)</td>
</tr>
<tr>
<td>6–11</td>
<td>3696 (66)</td>
<td>1102 (75)</td>
<td>3183 (55)</td>
<td>1051 (72)</td>
</tr>
<tr>
<td>12 or more</td>
<td>755 (13)</td>
<td>200 (14)</td>
<td>403 (7)</td>
<td>129 (9)</td>
</tr>
<tr>
<td>All</td>
<td>5623 (100)</td>
<td>1459 (100)</td>
<td>5744 (100)</td>
<td>1449 (100)</td>
</tr>
</tbody>
</table>

* p Values of $t$ tests are less than 0.001 between the study year in both sexes.

(more than college studies). The participants were classified as current smokers—persons regularly smoking at least one cigarette each day during the past 30 days—and non-smokers. Respondents who reported that they had less than one time leisure time physical activity on average per week were considered as having a lack of exercise.

Anthropometric measurements were done in the local health centres by the intensively trained local public health workers. Blood pressure was measured from the right arm using a standard mercury sphygmomanometer after five minutes of rest with the subject in the sitting position. The fifth phase Korotkoff sound was recorded as the diastolic pressure. The mean value of the two blood pressure measurements was used for the analysis. Hypertension was defined as systolic blood pressure $\geq 140$ mm Hg or diastolic blood pressure $\geq 90$ mm Hg, or both. Height and weight measurements were taken using a stadiometer and beam balance scale with subjects wearing usual light indoor clothing without shoes. Height and weight were measured twice and the mean values of the readings were used for the analysis. Overweight was defined as 25 $\leq$ body mass index (kg/m$^2$) $< 30$ and obesity as body mass index $\geq 30$. CVD risk factor clustering was also assessed by people who had more than two of the three CVD risk factors (hypertension, being overweight or obesity and cigarette smoking).

Differences in CVD risk factors between educational attainment, study year and time trends in the differences (interactions of education and study year) were examined by analysis of covariance for continuous variables and logistic regression analysis for categorical variables. The mean age of the study sample in 1996 was younger than that of the 1989 survey. This is because of the relatively fewer number of subjects aged 55–64 years in 1996. To improve the statistical power, we report the results of people who were overweight or obese in the same group as only 4% of men and 8% of women were obese (body mass index $\geq 30$) in the study sample. Also, when assessing cigarette smoking in women by education level between the study year, we have combined the two higher educational categories because there was only one self reported current smoker among the best educated women in 1996.

Results

Over the study period from 1989 to 1996, educational attainment increased significantly in the study population (table 2). There were no downward trends in major unadjusted levels of the CVD risk factors in men over the study period. In contrast, in women unadjusted levels of the CVD risk factors seemed to decrease with the exception of the universal increases of diastolic blood pressure and cigarettes consumed each day among current smokers in both sexes (table 3).

Most CVD risk factors were inversely associated with educational attainment in the study population. The association was more consistent in women than in men (tables 4 and 5). Over the seven year study period, diastolic blood pressure increased and the proportion of people who did not take leisure time physical activity decreased significantly in both men and women. However, 74% of men and 76% of women still did not have leisure time exercise in 1996 (table 3).

For men, the number of cigarettes smoked daily and the percentage of current smokers increased significantly between 1989 and 1996. The study year by education interaction was statistically significant for the prevalence of smoking, indicating that while the prevalence...
of smoking declined in the least educated men, it increased steeply in the best educated men over the study period. Nevertheless, the best educated men still contained the smallest proportion of current smokers (table 4).

For women, systolic blood pressure increased in those who had better than college level studies and decreased in the least educated women, although there was no time trend between the two surveys (table 5). Body mass index decreased across all educational groups over the study period.

Additional analyses showed that the probability of having CVD risk factor clustering increased across all of the educational strata among men, with the best educated men having the greatest increases (31%) in 1996 compared with their counterparts in 1989. In contrast, the probability of having the risk factor clustering decreased in women with less than high school studies and was almost

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Not all educational differences in risk factor clustering were sustained across the study period. Educational differences remained stable in those with at least college level education, but the risk factors for the least educated were increasing irrespective of the education level. The deterioration of the risk factors seemed to be more pronounced among the least educated. The reason that diastolic blood pressure increased irrespective of the education level in both sexes remains unknown. Blood pressure is positively associated with salt intake and body mass index and to a lesser extent, it is inversely associated with cigarette smoking. Our data showed that body mass index levelled off in men and decreased in women. Cigarette smoking increased in men and decreased in women. There is some evidence that there were no major changes in salt intake in the study population during this study period. It seems likely that the evidence presented here cannot account for the overall increases in diastolic blood pressure in the study population.

The deterioration of the risk factors seemed to be more pronounced among the least educated. Highly educated people experience an earlier onset or display a faster decline in CVD risk factors compared with less educated people. There are no upward trends in the risk factors found in highly educated people. Winkleby et al pointed out that education might, in some way, influence risk for disease rather than vice versa—that is, risk factors could influence the extent of education. Higher levels of education may positively affect health by allowing the person to gather the necessary skills and assets required to insulate them from adverse factors or to reduce exposure to negative influences on health, adopting a positive health behaviour and having access to preventive health services. In this study, the

**Figure 1** Relative risks of people who had more than two of the three CVD risk factors (hypertension, cigarette smoking and overweight or obesity) by sex and years of education in Tianjin, China, 1989 and 1996. The relative risks have been adjusted for age. The reference group is the best educated people in 1989 (relative risk = 1.0).
better educational level, however, did not seem to be able to prevent the worsening of the risk factors in those highly educated people even though the best educated people still had the lowest levels of risk factors.

In our study, there were some improvements in the risk factors found in women. However, a deterioration in some of the risk factors took place in men. It is also apparent that the best educated men tended to experience a relatively greater deterioration. Our data may indicate the need of CVD prevention with respect to socioeconomic disparities and gender differences in developing countries.

CVD has been described as a marker of modernisation and social affluence26 and can mirror a society’s stage of economic development.26 From the mid-1980s to the mid-1990s, the Chinese economy experienced strong growth, with an average annual 8.3% increase in gross national product per capita.27 During this period, CVD became the leading cause of death, especially in urban areas. A strong growth, with an average annual 8.3% increase in gross national product per capita.27 During this period, CVD became the leading cause of death, especially in urban areas. A
