# Associations between socioeconomic status and cardiovascular risk factors in an urban population in China

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**Introduction** In developed countries socioeconomic status has been proven to be an important factor in the progression of cardiovascular disease. The present article reports the results of a cross-sectional assessment to investigate the association between socioeconomic status and cardiovascular risk factors in a Chinese urban population.

**Methods** In 1996, a behavioural risk factor survey was carried out in Tianjin, the third largest city in China. A sample of 4000 people aged 15–69 years, stratified by sex and 10-year age groups, was drawn randomly from urban areas of the city. The present study covers respondents aged 25–69 years (1615 men and 1592 women). Four socioeconomic indicators (education, occupation, income, and marital status), blood pressure, body mass index, and cigarette smoking were determined in the survey.

**Results** Educational level seemed to be the most important measure of the four socioeconomic indicators in relation to the cardiovascular risk factors in the study population. People with lower socioeconomic status had higher levels of cardiovascular risk factors. The association between socioeconomic status and cardiovascular risk factors was more consistent among women than men.

**Discussion** Our findings do not seem to differ from those observed in developed countries.

**Keywords:** cardiovascular diseases, epidemiology; socioeconomic factors; risk factors; urban population; cross-sectional studies; China.

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## Introduction

Although cardiovascular disease (CVD) has been falling as a major cause of death in developed countries, it is on the increase in developing countries (*1–3*). It has been shown consistently that socioeconomic status (SES) is inversely associated with cardiovascular morbidity and mortality (*4–8*). In developed countries, the declining trend in CVD has been more pronounced among individuals in higher socioeconomic groups, and the differences in the occurrence of CVD between higher and the lower socioeconomic groups is widening (*8–12*). Regardless of which measure of SES is used, there is abundant evidence for the existence of an inverse relationship between SES and cardiovascular risk factors in developed countries, with only few exceptions (*12*). Preventive activities contributing to the decline in CVD might have had a greater impact on individuals' health in higher socioeconomic groups and resulted in widening cardiovascular disparities in industrialized societies (*13, 14*).

China is the largest developing country in the world and CVD has become the major cause of death especially in urban areas (*15*) such as Tianjin, the third largest city in the country. Mortality from heart diseases and stroke accounted for 51–56% of all deaths in the mid-1980s in the city. In 1984, a community-based intervention programme, the Tianjin Project, aimed at the prevention and control of CVD through lifestyle and risk factor changes, was initiated in the city (*16*). This was the first attempt to identify ways to prevent and control chronic diseases in China (*17*). Few assessments have been carried out to examine the association between SES and

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cardiovascular risk factors in China. For example, Tian et al. reported that blood pressure was inversely associated with level of education in an urban population (*18*); and middle-aged male workers with lower educational attainment or heavier labour intensity had increased levels of cardiovascular risk factors in a study sample from seven steel and metal plants (*19*). Previous reports from China quantifying the effects of different dimensions of SES on cardiovascular risk factors are sparse. A population survey carried out in Tianjin provided an opportunity for us to conduct a cross-sectional assessment of SES and cardiovascular risk factors. The aim of this study was to investigate the association between education, occupation, income, and marital status, and three cardiovascular risk factors — blood pressure, body mass index, and cigarette smoking.

## Materials and methods

In 1996, a cross-sectional population survey was conducted in the city of Tianjin. This survey serves as the baseline for a 5-year intervention programme that was funded by the World Bank. The aims of this programme are to decrease levels of behavioural risk factors for noncommunicable chronic diseases, injuries, and sexually transmitted diseases through legislative and environmental changes using the population approach intervention strategy (*20*). The programme was started in 1996 and will be completed in 2000.

The city of Tianjin has a population of 9.5 million, of whom 4 million people live in the six urban districts. The sample of this study was drawn using a two-stage sampling. First, 14 communities comprising 400 000 inhabitants were drawn randomly from these six urban districts. The sample included at least two communities from each district. In the second stage, 4000 individuals aged 15–69 years were drawn randomly from the local population registers in the sampled communities. The sample was stratified by sex and into five 10-year age groups (oldest age group, 55–69 years). The subsample of each sampled community was almost the same size. The overall response rate was 100%. The number of persons in the five age strata were as follows: age range 15–24 years: 793 (19.8%; 399 men and 394 women); age range 25–34 years: 815 (20.4%; 410 men and 405 women); age range 35–44 years: 811 (20.3%; 409 men and 402 women); age range 45–54 years: 781 (19.5%; 390 men and 391 women); and age range 55–69 years: 800 (20%; 406 men and 394 women). The present analyses are restricted to 3207 respondents aged 25–69 years (1615 men and 1592 women).

The survey included a self-administered questionnaire and an anthropometric measurement. The questionnaire, which mainly dealt with socioeconomic factors, health status, health care and service, health behaviour, and health knowledge, was completed by home interview. The participants were invited to attend the health centres in the study communities for determination of height, weight, and blood pressure. All observers, who were intensively trained before the field survey, were local public health workers in the health centres of the sampled communities.

Information on SES was collected via questionnaires. Years of education were divided into three categories: 0–6 years, 7–12 years, and $\geqslant$ 13 years. Occupation was classified into three categories: white-collar workers, blue-collar workers, and unemployed, retired and housewives. According to the reported average monthly income per capita of the participant's family, expressed as *yuan* (US$ 1 = 8.3 *yuan*), income was grouped into three categories: low (< 300 *yuan*), medium (300–500 *yuan*), and high (> 500 *yuan*). Marital status was dichotomized as married or single, with the latter including unmarried, divorced, and widowed individuals.

Blood pressure was measured from the right arm using a standard mercury sphygmomanometer after 5 min of rest with the subject in the sitting position. Following the WHO MONICA Project methodology, blood pressure was measured twice, and the mean value of the two measurements was used for the analysis. Hypertension was defined as systolic blood pressure $\geqslant$ 160 mmHg and/or diastolic blood pressure $\geqslant$ 95 mmHg, or the use of antihypertensive treatment. Height and weight measurements were taken using a stadiometer and beam balance scale with subjects wearing usual light indoor clothing but no shoes. Height and weight were measured twice, and the mean values of the readings were used for the analysis. Body mass index was calculated by dividing the subject's weight by the square of the height ($kg/m^2$). Obesity was defined as body mass index $\geqslant$ 30. Smoking was assessed using a set of questions in the self-administered questionnaire. Based on the response, the participants were classified into two categories: current smokers — persons who had smoked regularly and smoked at least one cigarette on average each day during the previous 30 days; others were considered to be non-smokers.

The statistical analyses were carried out at the University of Kuopio, Finland, using SPSS software. The differences in levels of cardiovascular risk factors between men and women were tested by Student's *t*-test or the $\chi^2$ test. The relationship among the four socioeconomic indicators and the three cardiovascular risk factors was tested by analysis of covariance (ANCOVA) for continuous variables and by logistic regression analysis for categorical variables. We explored two models to estimate the association among the four socioeconomic indicators and the three cardiovascular risk factors.

- Model 1: analysis with adjustment for age only; no interactions among the four indicators were examined.
- Model 2: multivariate analysis with adjustment for age; when the association of one socioeconomic indicator and the cardiovascular risk factors was assessed, all the other three socioeconomic

indicators were entered into the analysis as covariates for evaluating whether the relationship is independent of the other socioeconomic indicators. We also detected interactions among the four socioeconomic indicators using this model.

No significant interactions among the four socioeconomic indicators were found at any level. When calculating the odds ratios for the three cardiovascular risk factors among different levels of SES, we created dummy variables using the highest SES as the reference category, i.e. ⩾ 13 years of education, white-collar workers, high income, and married people.

## Results

In general, men had significantly higher mean levels of systolic and diastolic blood pressure, smoked more cigarettes each day, and had a significantly higher prevalence of cigarette smoking than women. The proportion of women who were obese was significantly greater than that of men (Table 1). Women were also more likely than men to be less educated and to report having lower incomes. Men were more likely to be employed than women (Table 2).

For men there were no consistent significant associations between the socioeconomic variables and age-adjusted mean values of systolic and diastolic blood pressure and body mass index. Nevertheless, men with lower incomes had significantly higher mean diastolic blood pressures. The least-educated men and men who were blue-collar workers smoked the greatest number of cigarettes per day. After multivariate adjustment, diastolic blood pressure and the number of cigarettes smoked daily were inversely related to income and education, respectively. The inverse association between occupation and systolic blood pressure was marginally significant in both age-adjusted and multivariate adjusted analyses (Table 3).

For women, educational attainment and occupation were consistently and inversely associated with mean values of systolic and diastolic blood pressures, body mass index, and number of cigarettes smoked per day in age-adjusted analyses. Income had inverse relationships with systolic blood pressure and number of cigarettes smoked daily. Marital status was inversely associated with body mass index and number of cigarettes smoked daily. After taking into account the other three socioeconomic indicators and age, education was inversely associated with systolic blood pressure and number of cigarettes smoked daily. The association between education and diastolic blood pressure was marginally significant. Occupation was inversely associated with body mass index and number of cigarettes smoked daily. Marital status was still inversely associated with body mass index. The other relationships became non-significant (Table 4).

In age-adjusted analyses, men who had less than 12 years of education were 1.6 times more likely to be current smokers compared with the most educated men. Men who had the lowest incomes were 1.4 times more likely to be smokers compared with men who had the highest incomes. Men who were blue-collar workers were 2.89 times more likely to be obese (95% confidence interval (CI) = 0.98–8.53; $P = 0.055$) compared with male white-collar workers. Single men had a relative risk of 2.10 of being obese compared with married men. Following multivariate adjustment, men who had less than 12 years of education were 1.7 times more likely to be current smokers compared with the most educated men; men in the lower occupational grade had a >3.5-fold increased risk of being obese compared with men in the highest occupational group. Men with medium incomes were 50% less likely to be obese compared with men who had the highest incomes

Table 1. **Cardiovascular risk factor levels among study subjects aged 25–69 years, by sex**

| | Men ($n$ = 1615)[a] | Women ($n$ = 1592)[a] | $P$-value |
|---|---|---|---|
| | Mean or proportion | Mean or proportion | Men vs women |
| Systolic blood pressure (mmHg) | 129 (18) | 125 (11) | <0.001 |
| Diastolic blood pressure (mmHg) | 83 (10)[b] | 81 (11) | <0.001 |
| Body mass index (kg/m$^2$) | 23.8 (3.4) | 24.0 (3.9) | 0.068 |
| No. of cigarettes smoked per day | 11.3 (12.7) | 1.7 (5.5) | <0.001 |
| Hypertension[c] (%) | 18.4; *16.5–20.3*[d] | 18.8; *16.9–20.7* | 0.769 |
| Obesity[e] (%) | 3.2; *2.4–4.2* | 6.9; *5.7–8.2* | <0.001 |
| Current smokers[f] (%) | 67.9; *65.6–70.1* | 14.3; *12.6–16.9* | <0.001 |

[a] $n$ varies slightly depending on risk factor and socioeconomic status.

[b] Figures in parentheses are standard deviations.

[c] Systolic blood pressure ⩾ 160 mmHg and/or diastolic blood pressure ⩾ 95 mmHg, or use of antihypertensive treatment.

[d] Figures in italics are 95% confidence interval.

[e] Body mass index ⩾ 30.

[f] People who had smoked regularly and smoked at least one cigarette on average each day during the previous 30 days.

(Table 5). The associations between income and cigarette smoking and between marital status and obesity were attenuated.

After adjustment for age, women with ⩽ 6 years or 7–12 years of education had an increased risk (29-fold and 11.6-fold, respectively) of being current smokers compared with the most educated women (Table 6). Women who were blue-collar workers were 2.62 times more likely to be current smokers compared with their white-collar counterparts; and women who had the lowest incomes were 1.72 times more likely to be current smokers compared with women who had the highest incomes. In multivariate analyses including all the other three socioeconomic indicators and age, women with lower educational attainment were still at an increased risk of being current smokers compared with the most educated women, but all other associations became nonsignificant

Table 2. **Distribution of four socioeconomic indicators among the study subjects**

| Indicator | No. of men | No. of women |
|---|---|---|
| **Years of education** | | |
| 0–6 | 223 (14)[a] | 394 (25) |
| 7–12 | 1167 (72) | 1066 (67) |
| ⩾ 13 | 223 (14) | 132 (8) |
| All | 1613 (100) | 1592 (100) |
| **Occupation** | | |
| White-collar workers | 370 (23) | 296 (19) |
| Blue-collar workers | 883 (55) | 727 (46) |
| Unemployed, retired and housewives | 347 (22) | 545 (35) |
| All | 1600 (100) | 1568 (100) |
| **Income** | | |
| Low | 468 (29) | 579 (36) |
| Medium | 717 (45) | 651 (41) |
| High | 428 (26) | 360 (23) |
| All | 1613 (100) | 1590 (100) |
| **Marital status** | | |
| Married | 1453 (90) | 1401 (88) |
| Single | 162 (10) | 191 (12) |
| All | 1615 (100) | 1592 (100) |

[a] Figures in parentheses are percentages.

## Discussion

Our results showed that, in age-adjusted analyses, educational level was inversely associated with mean values of blood pressure and body mass index for women, and with cigarette smoking for both sexes. Even after adjusting for the other three socioeconomic indicators, educational level was still the most consistent predicator of cigarette smoking for both sexes and was inversely associated with systolic blood pressure for women. The effects of occupation, income, and marital status varied for both sexes. These findings suggest that education seemed to be the most important of the four socioeconomic indicators in relation to cardiovascular risk factors among the study population. As far as we are aware, there are only a few studies simultaneously comparing different SES in developed countries. Similar data for developing countries are not available. The study of Winkleby et al. (*21*), which employed a forward selection model that permitted inclusion of education, occupation, and income and controlled for potential confounding factors, revealed that educational level was the only measure of SES significantly associated with cardiovascular risk factors in an American population. Helment et al. (*22*) found that educational level was more strongly associated with cardiovascular risk factors than occupation and income among the population of the Federal Republic of Germany. A study carried out in Finland (*23*) concluded that although education and occupation had the strongest associations with cardiovascular risk factors, education seemed to be most important among men, while among women income seemed to be an additional important determinant of risk factors. Marital status did not contribute to the risk factors. Our findings appear to be in agreement with these conclusions. Although no single socioeconomic indicator is universally valid and suitable for all populations (*21, 22*), education seems to be a relatively stronger indicator in evaluating the association between SES and cardiovascular risk factors.

In our study, Chinese men seemed to have relatively higher SES than women, which has been reported in developed countries (*21–25*). Women, on the other hand, tended to have relatively lower levels of risk factors than men except for the prevalence of obesity. This is similar to the situation in other developing countries reported in the WHO Inter-Health Programme (*26*) but not the case in developed countries (*14, 23, 24, 26, 27*).

Overall, people with lower SES tended to have higher levels of cardiovascular risk factors. Men with higher SES tended to have lower mean blood pressure levels, smoked fewer cigarettes per day, and had lower relative risks of being obese and of being current smokers. An exception to this pattern was that men who had medium incomes had a lower probability of being obese compared with men who had high incomes. Women with lower SES seemed to have higher mean blood pressure levels, body mass index and relative risk of being current smokers, and smoked more cigarettes per day. The most consistent association was the inverse relationship between SES and cigarette smoking. However, results from ANCOVA and from logistic regression analysis showed no consistent correlation between mean blood pressure and the risk of hypertension or between mean body mass index and the risk of obesity. A large number of studies relating SES and the three cardiovascular risk factors have been carried out in developed countries. SES is consistently and inversely associated with cigarette smoking in the USA (*6, 21, 28–34*), European countries (*13, 24, 35–*

Table 3. **Adjusted mean levels of cardiovascular risk factors, by four socioeconomic indicators, for study men aged 25–69 years**

| Variable | Model 1[a] | | | | Model 2[b] | | | |
|---|---|---|---|---|---|---|---|---|
| | Systolic blood pressure (mmHg) | Diastolic blood pressure (mmHg) | Body mass index (kg/m$^2$) | No. of cigarettes smoked per day | Systolic blood pressure (mmHg) | Diastolic blood pressure (mmHg) | Body mass index (kg/m$^2$) | No. of cigarettes smoked per day |
| **Years of education** | | | | | | | | |
| 0–6 | 131 | 84 | 23.6 | 12.5 | 130 | 84 | 23.6 | 12.7 |
| 7–12 | 128 | 83 | 23.8 | 11.5 | 128 | 83 | 23.8 | 11.5 |
| ⩾ 13 | 129 | 83 | 23.9 | 8.6 | 130 | 83 | 23.9 | 8.6 |
| *P*-value | 0.215 | 0.206 | 0.674 | 0.003 | 0.151 | 0.366 | 0.685 | 0.010 |
| | (1611)[c] | (1611) | (1609) | (1613) | (1594) | (1594) | (1592) | (1596) |
| **Occupation** | | | | | | | | |
| White-collar workers | 127 | 82 | 23.7 | 10.6 | 127 | 82 | 23.6 | 11.4 |
| Blue-collar workers | 129 | 83 | 23.8 | 12.1 | 129 | 83 | 23.9 | 11.8 |
| Unemployed and retired persons | 130 | 83 | 23.6 | 9.9 | 129 | 83 | 23.7 | 9.7 |
| *P*-value | 0.062 | 0.434 | 0.699 | 0.030 | 0.061 | 0.543 | 0.441 | 0.120 |
| | (1598) | (1598) | (1596) | (1600) | ( 1594) | (1594) | (1592) | (1596) |
| **Income** | | | | | | | | |
| Low | 130 | 84 | 23.5 | 11.5 | 130 | 84 | 23.5 | 11.0 |
| Medium | 128 | 83 | 23.8 | 10.8 | 128 | 83 | 23.8 | 10.9 |
| High | 128 | 82 | 23.9 | 11.7 | 128 | 82 | 23.9 | 12.1 |
| *P*-value | 0.096 | 0.013 | 0.124 | 0.606 | 0.161 | 0.036 | 0.109 | 0.289 |
| | (1611) | (1611) | (1609) | (1613) | (1594) | (1594) | (1 592) | (1596) |
| **Marital status** | | | | | | | | |
| Married | 129 | 83 | 23.8 | 11.4 | 129 | 83 | 23.8 | 11.3 |
| Single | 130 | 84 | 23.7 | 10.4 | 129 | 84 | 23.7 | 10.5 |
| *P*-value | 0.448 | 0.236 | 0.676 | 0.343 | 0.589 | 0.233 | 0.766 | 0.450 |
| | (1613) | (1613) | (1611) | (1615) | (1594) | (1594) | (1592) | (1596) |

[a] Adjusted for age only.

[b] Adjusted for age and the other three socioeconomic indicators.

[c] Figures in parentheses are numbers of study subjects.

*40*), and Australia (*25*). Our results are in good agreement with the studies carried out in these countries.

The relationship between SES and blood pressure or body mass index is less consistent than that of smoking. In the USA, the Stanford Five-City Project showed that age-adjusted mean systolic and diastolic blood pressure, body mass index, and prevalence of hypertension were inversely associated with level of education in both sexes (*28, 29*). When income and occupation were taken into account, those relationships persisted among women only (*21*). Three studies that used either univariate (*30, 31, 41, 42*) or a combination (*43*) of SES variables showed consistent inverse associations between SES and age-adjusted mean blood pressure and prevalence of hypertension (*30, 31, 40*), while a fourth such study did not (*42*). Body mass index was consistently and inversely associated with SES in women but not in men (*30, 43*).

In Western European countries, the association between SES and blood pressure is heterogeneous. In Norway, for example, age-adjusted mean systolic and diastolic blood pressures were inversely associated with SES in women (*24*); in men, the relationship was apparent only for systolic blood pressure (*24, 35*). Inverse relationships between SES and age-adjusted mean diastolic blood pressure (*37*) and prevalence of hypertension (*36*) were found for both sexes in Finland. SES was not related to prevalence of hypertension in a Swedish study (*14, 44*). In England, men in lower socioeconomic groups had higher age-adjusted mean systolic blood pressure but not diastolic blood pressure (*38*). The prevalence of hypertension was inversely related to SES in women but not in men in the Federal Republic of Germany (*22, 39*). Age-adjusted mean body mass index was strongly and inversely related to SES both in men and women in the Nordic countries (*14, 24, 34, 44–47*), England (*38*), and the Federal Republic of Germany (*22, 39*).

In Australia, blood pressure, body mass index, prevalence of hypertension, and prevalence of obesity are inversely associated with SES both in men and women (*25*).

Our results indicate that SES has differential relationships with cardiovascular risk factors in men and women. Significant association was more

Table 4. **Adjusted mean levels of cardiovascular risk factors, by four socioeconomic indicators, for study women aged 25–69 years**

| Variable | Model 1[a] | | | | Model 2[b] | | | |
|---|---|---|---|---|---|---|---|---|
| | Systolic blood pressure (mmHg) | Diastolic blood pressure (mmHg) | Body mass index (kg/m$^2$) | No. of cigarettes smoked per day | Systolic blood pressure (mmHg) | Diastolic blood pressure (mmHg) | Body mass index (kg/m$^2$) | No. of cigarettes smoked per day |
| **Years of education** | | | | | | | | |
| 0–6 | 129 | 82 | 23.7 | 3.7 | 129 | 82 | 23.8 | 3.4 |
| 7–12 | 124 | 81 | 24.2 | 1.1 | 124 | 81 | 24.1 | 1.2 |
| ⩾ 13 | 121 | 78 | 23.4 | 0.4 | 122 | 78 | 23.7 | 0.5 |
| *P*-value | <0.001 | 0.003 | 0.039 | <0.001 | 0.007 | 0.064 | 0.504 | <0.001 |
| | (1589)[c] | (1589) | (1591) | (1592) | (1563) | (1563) | (1565) | (1566) |
| **Occupation** | | | | | | | | |
| White-collar workers | 123 | 79 | 23.6 | 1.0 | 125 | 80 | 23.7 | 1.5 |
| Blue-collar workers | 125 | 82 | 24.4 | 1.3 | 125 | 81 | 24.3 | 1.4 |
| Unemployed and retired persons, and housewives | 127 | 81 | 23.7 | 2.6 | 126 | 81 | 23.7 | 2.2 |
| *P*-value | 0.050 | 0.033 | 0.003 | <0.001 | 0.921 | 0.684 | 0.032 | 0.048 |
| | (1565) | (1565) | (1567) | (1568) | (1563) | (1563) | (1565) | (1566) |
| **Income** | | | | | | | | |
| Low | 127 | 81 | 24.1 | 2.2 | 126 | 81 | 24.1 | 1.9 |
| Medium | 125 | 81 | 23.8 | 1.5 | 125 | 81 | 23.8 | 1.4 |
| High | 123 | 80 | 24.0 | 1.6 | 124 | 80 | 24.1 | 1.8 |
| *P*-value | 0.016 | 0.087 | 0.388 | 0.037 | 0.158 | 0.434 | 0.376 | 0.243 |
| | (1587) | (1587) | (1589) | (1590) | (1563) | (1563) | (1565) | (1566) |
| **Marital status** | | | | | | | | |
| Married | 125 | 81 | 24.1 | 1.6 | 125 | 81 | 24.1 | 1.6 |
| Single | 135 | 80 | 23.2 | 12.7 | 124 | 80 | 23.4 | 2.3 |
| *P*-value | 0.792 | 0.625 | 0.004 | 0.005 | 0.502 | 0.639 | 0.019 | 0.097 |
| | (1589) | (1589) | (1591) | (1592) | (1563) | (1563) | (1565) | (1566) |

[a] Adjusted for age only.

[b] Adjusted for age and the other three socioeconomic indicators.

[c] Figures in parentheses are numbers of study subjects.

apparent for women than men. Different socioeconomic indicators may describe different aspects of socioeconomic position, e.g. education indicates skills requisite for acquiring positive social, psychological, and economic resources; occupation measures prestige, responsibility, physical activity, and work exposure; income reflects spending power, diet, and medical care (*21–23*). Different socioeconomic indicators may have different effects on individual health; men and women may express different health outcomes even though they are exposed to the same SES. Moreover, the results from the synergistic effect of various components of SES in men and women may differ. However, the underlying mechanisms through which SES may affect cardiovascular disease are not well understood (*12, 48*).

The differential contribution to cardiovascular risk factors within the different socioeconomic groups was larger among women than men in this Chinese study population. For example, the maximum difference in systolic blood pressure between the highest and the lowest educational categories was 2 mmHg for men but 7 mmHg for women. Community-based interventions to prevent chronic diseases have been ongoing in Tianjin since 1990. These include nutrition intervention, a hypertension control programme, and an anti-smoking programme (*16*). Public health messages about how to modify unhealthy lifestyles have been widespread in urban areas (*16, 18, 49*). The impact of interventions on lifestyle may differ between men and women and among socioeconomic groups. Women in higher socioeconomic groups may be more exposed to health information and be more likely than men to modify their unhealthy lifestyles. In developed countries, socioeconomic inequalities among CVD risk factors are more pronounced for women than for men (*9, 10, 22, 25*). Recently, this type of disparity by sex has even been accentuated, although CVD mortality has decreased dramatically in such countries (*25, 30, 37*).

Our findings therefore suggest that education seems to be the strongest measure for assessing the association between SES and CVD risk factors for

Table 5. **Adjusted odds ratios (OR) and 95% confidence intervals (CI) for the associations between four socioeconomic indicators and hypertension, obesity, and smoking among study men aged 25–69 years**

| Indicator | Model 1[a] | | | | | | Model 2[b] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hypertension | | Obesity | | Smoking | | Hypertension | | Obesity | | Smoking | |
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| **Years of education** | | | | | | | | | | | | |
| 0–6 | 0.81 | 0.50–1.23 | 1.57 | 0.60–4.13 | 1.61 | 2.7–2.41 | 0.61 | 0.35–1.05 | 0.94 | 0.32–2.77 | 1.69 | 1.07–2.68 |
| 7–12 | 0.93 | 0.63–1.37 | 0.87 | 0.38–2.03 | 1.66 | 1.23–2.25 | 0.76 | 0.48–1.19 | 0.55 | 0.21–1.45 | 1.74 | 1.22–2.49 |
| ⩾ 13 | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | | 1.00 | |
| **Occupation** | | | | | | | | | | | | |
| White-collar workers | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| Blue-collar workers | 0.95 | 0.62–1.45 | 2.89 | 0.98–8.53 | 0.87 | 0.61–1.23 | 1.02 | 0.64–1.62 | 3.59 | 1.10–11.66 | 0.68 | 0.47–1.00 |
| Unemployed and retired persons | 1.25 | 0.88–1.79 | 2.41 | 0.92–6.31 | 1.14 | 0.87–1.49 | 1.44 | 0.95–2.20 | 3.57 | 1.18–10.79 | 0.85 | 0.62–1.17 |
| **Income** | | | | | | | | | | | | |
| Low | 1.17 | 0.82–1.67 | 0.65 | 0.32–1.34 | 1.37 | 1.03–1.84 | 1.18 | 0.81–1.71 | 0.54 | 0.26–1.14 | 1.30 | 0.96–176 |
| Medium | 0.94 | 0.68–1.30 | 0.58 | 0.30–1.10 | 1.01 | 0.78–1.31 | 0.93 | 0.67–1.30 | 0.50 | 0.26–0.97 | 0.97 | 0.75–1.27 |
| High | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| **Marital status** | | | | | | | | | | | | |
| Married | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| Single | 1.26 | 0.81–1.95 | 2.15 | 1.02–4.52 | 0.86 | 0.60–1.24 | 1.41 | 0.90–2.22 | 2.00 | 0.93–4.31 | 0.91 | 0.63–1.32 |

[a] Adjusted for age only.

[b] Adjusted for age and the other three socioeconomic indicators.

Table 6. **Adjusted odds ratios (OR) and 95% confidence intervals (CI) for the associations between four socioeconomic indicators and hypertension, obesity, and smoking among study women aged 25–69 years**

| Indicator | Model 1[a] | | | | | | Model 2[b] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hypertension | | Obesity | | Smoking | | Hypertension | | Obesity | | Smoking | |
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| **Years of education** | | | | | | | | | | | | |
| 0–6 | 1.89 | 0.95–3.77 | 1.77 | 0.58–5.37 | 29.02 | 3.94–213.80 | 2.00 | 0.92–4.34 | 1.55 | 0.45–5.29 | 25.14 | 3.26–193.76 |
| 7–12 | 1.42 | 0.74–2.73 | 1.93 | 0.69–5.43 | 11.62 | 1.60–84.46 | 1.46 | 0.73–2.92 | 1.62 | 0.54–4.89 | 10.96 | 1.47–81.50 |
| ⩾13 | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| **Occupation** | | | | | | | | | | | | |
| White-collar workers | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| Blue-collar workers | 1.21 | 0.77–1.88 | 1.05 | 0.53–2.09 | 2.62 | 1.49–4.60 | 0.95 | 0.58–1.56 | 0.95 | 0.44–2.03 | 1.32 | 0.71–2.46 |
| Unemployed and retired persons, and housewives | 1.07 | 0.69–1.66 | 1.66 | 0.88–3.16 | 1.64 | 0.92–2.92 | 0.86 | 0.54–1.40 | 1.47 | 0.73–2.97 | 0.91 | 0.50–1.67 |
| **Income** | | | | | | | | | | | | |
| Low | 1.23 | 0.85–1.78 | 1.13 | 0.67–1.91 | 1.72 | 1.13–2.60 | 1.15 | 0.77–1.72 | 1.04 | 0.59–1.83 | 1.17 | 0.75–1.83 |
| Medium | 1.13 | 0.79–1.62 | 0.98 | 0.58–1.64 | 1.18 | 0.78–1.79 | 1.08 | 0.74–1.57 | 0.94 | 0.55–1.61 | 0.94 | 0.94–1.45 |
| High | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| **Marital status** | | | | | | | | | | | | |
| Married | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – | 1.00 | – |
| Single | 0.84 | 0.56–1.26 | 0.86 | 0.48–1.55 | 1.36 | 0.91–2.04 | 0.79 | 0.52–1.19 | 0.90 | 0.49–1.66 | 1.18 | 0.77–1.80 |

[a] Adjusted for age only.

[b] Adjusted for age and the other three socioeconomic indicators.

this Chinese population. People with higher SES tend to have lower levels of CVD risk factors. The association between SES and CVD risk factors was more consistent for women than men.

While CVD has decreased in developed countries, it has increased and become the predominant public health problem in China, especially in urban areas. Although China is a developing country and is situated in the eastern part of Asia, and Chinese people have a different cultural background and lifestyle than those of Western populations, the association between SES and CVD risk factors does

not seem to differ from that observed in developed countries. It is important to note that results and experiences from developed countries of successful prevention and control of CVD have been accompanied by a widening of social inequalities with respect to cardiovascular morbidity, mortality, and risk factors. Although cardiovascular mortality has declined markedly in developed countries, it still is the major cause of death especially among the socially deprived. Health policy should encompass all levels of society, forming a wide and effective health promotion (*14, 37, 50*). Legislative action and environmental changes may be particularly important to China, which has just embarked on a programme to prevent and control CVD. ■

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## Résumé

### Association entre le niveau socio-économique et les facteurs de risque cardio-vasculaire dans une population urbaine de Chine

Le niveau socio-économique s'est avéré un facteur important dans l'évolution des pathologies cardio-vasculaires dans les pays développés. Toutefois, il existe peu de données sur l'association entre niveau socio-économique et facteurs de risque cardio-vasculaire dans les pays en développement. La Chine est le pays en développement le plus grand du monde. Dans ce pays, les rapports antérieurs quantifiant les effets des différentes composantes du niveau socio-économique sur les facteurs de risque cardio-vasculaire sont rares. C'est pourquoi nous avons effectué une évaluation transversale afin d'étudier l'association qui existe entre éducation, profession, revenu et état civil d'une part, et trois facteurs de risque cardio-vasculaire de l'autre – tension artérielle, indice de Quételet et tabagisme – dans la population urbaine de Tianjin en Chine.

En 1996, une enquête transversale en population a été menée à Tianjin, troisième ville de Chine. L'échantillon de cette étude a été obtenu à l'aide d'un échantillonnage à deux degrés. On a d'abord choisi au hasard dans la zone urbaine 14 communautés comprenant 400 000 habitants. Dans un deuxième temps, on a choisi au hasard 4000 individus âgés de 15 à 69 ans dans les registres d'état civil des communautés échantillonnées. L'échantillon a ensuite été stratifié selon le sexe et la classe d'âge (classe d'âge la plus élevée, 55 à 69 ans). La présente étude ne porte que sur les enquêtés âgés de 25 à 69 ans (1615 hommes et 1592 femmes). On a recherché dans cette enquête à recueillir des données concernant quatre indicateurs socio-économiques (éducation, profession, revenu et état civil), ainsi qu'à déterminer la tension artérielle, l'indice de Quételet et le degré de tabagisme de tous les participants.

L'éducation semble être le plus important des indicateurs socio-économiques en rapport avec les facteurs de risque cardio-vasculaire dans la population d'étude. En général, les sujets ayant un niveau socio-économique inférieur présentent davantage de facteurs de risque, et l'association entre le niveau socio-économique et les facteurs de risque cardio-vasculaire est plus systématique chez la femme que chez l'homme. De plus, l'importance des différences observées est plus grande chez la femme que chez l'homme. Nos résultats ne semblent pas différer de ceux observés dans les pays en développement.

## Resumen

### Relación entre la situación socioeconómica y los factores de riesgo de enfermedades cardiovasculares en una población urbana de China

Se ha demostrado que la situación socioeconómica (SSE) es un factor importante en la progresión de las enfermedades cardiovasculares en los países desarrollados. En cambio, hay pocos datos sobre la relación entre la SSE y los factores de riesgo de contraer dichas enfermedades en los países en desarrollo. China es el país en desarrollo más grande del mundo, pero los informes precedentes de ese país en que se cuantifican los efectos de diferentes dimensiones de la SSE en los factores de riesgo cardiovascular son escasos. Por esta razón, realizamos una evaluación transversal para investigar la relación entre el grado de instrucción, la ocupación, los ingresos y el estado civil, por un lado, y tres factores de riesgo de enfermedad cardiovascular — tensión arterial, índice de masa corporal y hábito de fumar — entre la población urbana de Tianjin, la tercera ciudad más populosa de China.

En 1996 se realizó una encuesta de población transversal en Tianjin. La muestra para ese estudio se obtuvo por un procedimiento en dos etapas. Primero se tomaron al azar en la zona urbana 14 comu-nidades con un total de 400 000 habitantes. En la segunda etapa se tomaron al azar de los registros de población, en las comunidades muestreadas, 4000 per-sonas de edad comprendida entre 15 y 69 años. La muestra se estratificó por sexos y grupos de edad (el grupo de más edad, 55–69 años). El presente estudio se ha limitado a las personas entrevistadas de edad comprendida entre 25 y 69 años (1615 varones y 1592 mujeres). Se determinaron en la encuesta cuatro indicadores socioeconómicos (grado de instrucción, ocupación, ingresos y estado civil), así como la tensión arterial, el índice de masa corporal y el hábito de fumar de los participantes.

El grado de instrucción parece ser el más importante de los cuatro indicadores socioeconómicos en relación con los factores de riesgo cardiovascular en la población estudiada. En general, las personas con SSE más baja tenían niveles más altos de factores de riesgo cardiovascular, y la relación entre la SSE y los factores de riesgo cardiovascular fue más sistemática en las mujeres que en los varones. Asimismo, las diferencias fueron más amplias en las mujeres que en los varones. Nuestros hallazgos no parecen diferir de los observados en los países desarrollados.

## References


1. **Fox R.** Cardiovascular news: trends in cardiovascular mortality in Europe. *Circulation*, 1997, **96**: 3817.
2. **Reddy KS.** Cardiovascular disease in the developing countries. *Heartbeat*, 1998, **2**: 4.
3. **Marmot M, Elliott P.** *Coronary heart disease epidemiology: from aetiology to public health*. Oxford, Oxford University Press, 1995: 1–17.
4. **Woodward M et al.** Social status and coronary heart disease: results from the Scottish Heart Health Study. *Preventive Medicine*, 1992, **21**: 136–148.
5. **Salonen JT.** Socioeconomic status and risk of cancer, cerebral stroke, and death due to coronary heart disease and any disease: a longitudinal study in eastern Finland. *Journal of Epidemiology and Community Health*, 1982, **36**: 194–197.
6. **Liu K et al.** Relationship of education to major risk factors and death from coronary heart disease, cardiovascular diseases, and all causes: findings of three Chicago epidemiologic studies. *Circulation*, 1982, **66**: 1308–1314.
7. **Pekkanen J et al.** Social class, health behaviour, and mortality among men and women in eastern Finland. *British Medical Journal*, 1995, **311**: 589–593.
8. **Rose G, Marmot MG.** Social class and coronary heart disease. *British Heart Journal*, 1981, **45**: 13–19.
9. **Marmot MG et al.** Changing social-class distribution of heart disease. *British Medical Journal*, 1978, **2**: 1109–1112.
10. **Marmot MG, McDowall ME.** Mortality decline and widening social inequalities. *Lancet*, 1986, **2**: 274–276.
11. **Wing S et al.** Changing association between community occupational structure and ischaemic heart disease mortality in the United States. *Lancet*, 1987, **2**: 1067–1070.
12. **Kaplan GA, Keil JE.** Socioeconomic factors and cardiovascular disease: a review of the literature. *Circulation*, 1993, **88**: 1973–1998.
13. **Puska P et al.** *The North Karelia Project: 20 year results and experiences*. Helsinki, Helsinki University Printing House, National Public Health Institute Publications, 1995: 131–140.
14. **Brannstrom I et al.** Changing social patterns of risk factors for cardiovascular disease in a Swedish community intervention programme. *International Journal of Epidemiology*, 1993, **22**: 1026–1037.
15. **Tao SC et al.** CHD and its risk factors in the People's Republic of China. *International Journal of Epidemiology*, 1989, **18** (Suppl. 1): S159–S163.
16. **Tianjin Public Health Bureau, China.** *Ten-year achievement of Tianjin NCD prevention and control*. Tianjin, Public Health Bureau, 1994.
17. **Vartiainen E et al.** Mortality, cardiovascular risk factors, and diet in China, Finland, and the United States. *Public Health Report*, 1991, **5**: 59–67.
18. **Tian HG et al**. Dietary sodium and potassium, socioeconomic status, and blood pressure in a Chinese population. *Appetite*, 1996, **26**: 235–246.
19. **Siegrist J et al.** Socioeconomic differences in cardiovascular risk factors in China. *International Journal of Epidemiology*, 1990, **19**: 905–910.
20. **Rose G.** Sick individuals and sick populations. *International Journal of Epidemiology*, 1985, **14**: 32–38.
21. **Winkleby MA et al.** Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *American Journal of Public Health*, 1992, **82**: 816–820.
22. **Helmert U et al.** Relationship of social class characteristics and risk factors for coronary heart disease in West Germany. *Journal of Public Health*, 1990, **104**: 399–416.
23. **Luoto R et al.** Cardiovascular risks and socioeconomic status: differences between men and women in Finland. *Journal of Epidemiology and Community Health*, 1994, **48**: 348–354.
24. **Jacobsen BK, Thelle DS.** Risk factors for coronary heart disease and level of education: the Tromso Heart Study. *American Journal of Epidemiology*, 1988, **127**: 923–932.
25. **Bennett S.** Cardiovascular risk factors in Australia: trends in socioeconomic inequalities. *Journal of Epidemiology and Community Health*, 1995, **49**: 363–372.
26. **Berrios X et al.** Distribution and prevalence of major risk factors of noncommunicable diseases in selected countries: the WHO Inter-Health Programme. *Bulletin of the World Health Organization*, 1997, **75**: 99–108.
27. **Isles CG et al.** Relation between coronary risk and coronary mortality in women of the Renfrew and Paisley Survey: comparison with men. *Lancet*, 1992, **339**: 702–706.
28. **Winkleby MA, Fortmann SP, Rockhill B.** Trends in cardiovascular disease risk factors by educational level: the Stanford Five-City Project. *Preventive Medicine*, 1992, **21**: 592–601.
29. **Winkleby MA, Fortmann SP, Barrett DC.** Social class disparities in risk factors for disease: eight-year prevalence patterns by level of education. *Preventive Medicine*, 1990, **19**: 1–12.
30. **Luepker RV et al.** Socioeconomic status and coronary heart disease risk factor trends: the Minnesota Heart Survey. *Circulation*, 1993, **88**: 2172–2179.
31. **Garrison RJ et al.** Educational attainment and coronary heart disease risk: the Framingham Offspring Study. *Preventive Medicine*, 1993, **22**: 54–64.
32. **Matthews KA et al.** Educational attainment and behavioral and biologic risk factors for coronary heart disease in middle-aged women. *American Journal of Epidemiology*, 1989, **129**: 1132–1144.
33. **Pierce JP et al.** Trends in cigarette smoking in the United States: educational differences are increasing. *Journal of American Medical Association*, 1989, **261**: 56–60.
34. **Pierce JP et al.** Trends in cigarette smoking in the United States: projections to the year 2000. *Journal of American Medical Association*, 1989, **261**: 61–65.
35. **Holme I et al.** Coronary risk factors and socioeconomic status: the Oslo Study. *Lancet*, 1976, **2**: 1396–1397.
36. **Tuomilehto J et al.** Coronary risk factors and socioeconomic status in eastern Finland. *Preventive Medicine*, 1978, **7**: 539–549.
37. **Pekkanen J et al.** Coronary risk factor levels: differences between educational groups in 1972–87 in eastern Finland. *Journal of Epidemiology and Community Health*, 1995, **49**: 144–149.

38. **Smith GD, Shipley MJ, Rose G.** Magnitude and causes of socioeconomic differentials in mortality: further evidence from the Whitehall Study. *Journal of Epidemiology and Community Health*, 1990, **44**: 265–270.
39. **Helmert U et al.** Social class and risk factors for coronary heart disease in the Federal Republic of Germany. Results of the baseline survey of the German Cardiovascular Prevention Study (GCP). *Journal of Epidemiology and Community Health*, 1989, **43**: 37–42.
40. **Rosen M, Hanninh M, Wall S.** Changing smoking habits in Sweden: towards better health, but not for all. *International Journal of Epidemiology*, 1990, **19**: 316–322.
41. **Hypertension Detection and Follow-Up Cooperative Group.** Race, education, and prevalence of hypertension. *American Journal of Epidemiology*, 1977, **106**: 351–361.
42. **Dyer AR et al.** The relationship of education to blood pressure: findings on 40,000 employed Chicagoans. *Circulation*, 1976, **54**: 987–992.
43. **Croft JB et al.** Socioeconomic and behavioural correlates of body mass index in Black adults: the Pitt County Study. *American Journal of Public Health*, 1992, **82**: 821–826.
44. **Brannstrom I, Persson LA, Wall S.** Gender and social patterning of health: the Norsjo cardiovascular preventive programme in Northern Sweden 1985–1990. *Scandinavian Journal of Primary Health Care*, 1994, **12**: 155–161.
45. **Marti B et al.** Body fat distribution in the Finnish population: environmental determinants and predictive power for cardiovascular risk factor levels. *Journal of Epidemiology and Community Health*, 1991, **45**: 131–137.
46. **Kuskowska-Wolk A, Bergstrom R.** Trends in body mass index and prevalence of obesity in Swedish men 1980–1989. *Journal of Epidemiology and Community Health*, 1993, **47**: 103–108.
47. **Wamala SP, Wolk A, Orth-Gomer K.** Determinants of obesity in relation to socioeconomic status among middle-aged Swedish women. *Preventive Medicine*, 1997, **26**: 734–744.
48. **Salonen JT.** Is there a continuing need for longitudinal epidemiologic research? The Kuopio Ischaemic Heart Disease Risk Factor Study. *Annals of Clinical Research* 1988, **20**: 46–50.
49. **Tian HG et al.** Changes in sodium intake and blood pressure in a community-based intervention project in China. *Journal of Human Hypertension*, 1995, **9**: 959–968.
50. **Adler NE et al**. Socioeconomic inequalities in health. No easy solution. *Journal of the American Medical Association*, 1993, **269**: 3140–3145.