Short Report

Risk factors for cardiovascular diseases: Is the social gradient reversing in northern India?

S. S. KAR, J. S. THAKUR, N. K. VIRDI, S. JAIN, R. KUMAR

ABSTRACT

Background. In the past century, most developed countries witnessed a reversal of social gradient in cardiovascular diseases. To examine whether this phenomenon is also under way in developing countries, we assessed the prevalence of selected risk factors for cardiovascular diseases among different social groups living in urban and rural areas of northern India.

Methods. Four hundred adults ≥30 years of age, selected by cluster sampling, were surveyed from 8 purposively selected communities of Chandigarh and Haryana during 2004–05. The WHO STEPS tool for surveillance of risk factors was used to enquire about sociodemographic characteristics, tobacco use, alcohol intake, physical activity and to measure weight, height, blood pressure, and waist and hip circumference. Prevalence of risk factors such as tobacco use, physical inactivity, overweight (BMI ≥25 kg/m^2), and hypertension (≥140/90 mmHg or on anti-hypertension treatment) were estimated according to the area of residence and across educational categories after controlling for the effects of confounding variables.

Results. The prevalence of hypertension in urban (39%; 95% CI 29.5%–49.2%), slum (35%; 95% CI 27.2%–42.9%) and rural (33%; 95% CI 25.4%–40.8%) communities was found to be statistically similar ($p > 0.05$) after controlling for age, gender and education. The prevalence of physical inactivity (17% *v.* 12%), central obesity (90% *v.* 88%), overweight (20% *v.* 19%) and hypertension (34% *v.* 36%), were found to be statistically similar among literate and illiterate population after controlling for the effect of age, sex and place of residence ($p > 0.05$). However, the risk of tobacco use was significantly lower among literates (OR 0.3, 95% CI 0.1–0.8).

Conclusion. In selected communities of northern India, most of the cardiovascular disease risk factors did not have a social gradient except tobacco use, which was more common in the lower social group.

Natl Med J India 2010;23:206–9

School of Public Health, Post Graduate Institute of Medical Education and Research, Chandigarh 160012, India

SITANSHU SEKHAR KAR, J. S. THAKUR, N. K. VIRDI, R. KUMAR Department of Community Medicine

SANJAY JAIN Department of Internal Medicine

Correspondence to RAJESH KUMAR; *drrajeshkumar@gmail.com*

INTRODUCTION

The Indian population is undergoing epidemiological transition. The causes of death and disability are shifting from nutritional and infectious diseases to chronic diseases such as cardiovascular diseases (CVDs), diabetes and cancer.[1–4] However, CVDs are still considered to be diseases of the rich and elite urban population as risk factors for CVDs are found to be high in urban compared with rural people.[5–9] Even in urban areas, people in the higher socioeconomic strata have a higher prevalence of CVDs compared with those in the lower strata. A similar situation prevailed in developed countries, but later people in the lower socioeconomic strata had a higher occurrence of CVDs (reversal of social gradient). There are limited data on the reversal of social gradient in the distribution of CVDs and their risk factors in India.[10–13] Therefore, we did a study to find out the social gradient in CVD risk factors in selected communities of northern India.

METHODS

Study setting

A population-based, cross-sectional study was done in 8 communities of Chandigarh and Haryana from September 2004 to August 2005. These communities were selected because the Department of Community Medicine, Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh, which provided healthcare to these communities, extended their transport facilities to the study staff. The rural communities were located at a distance of 40–70 km from the city. Each of the selected communities is served by a health centre which caters to a population of approximately 5000 and is manned by 1 male and 1 female multipurpose health worker. Health workers maintain a household register containing demographic information of each household in the community. The first study household was randomly selected from the survey register in each of the study communities. From the first sampled household, consecutive households on the left-hand side were included in the survey till the required sample size of 50 persons per community was achieved. All eligible members (≥30 years of age) in every sampled household participated in the study. Thus, a total of 400 subjects from 188 households were enrolled after taking informed consent. This analysis was done from the baseline survey of an intervention trial which was done to study the feasibility of CVD risk management in a primary healthcare setting of northern India.[14]

Study tool

The WHO STEPS instrument for non-communicable disease risk factors (Core and Expanded Version 1.4) was used for data collection.[15] It is a structured, interview-based tool to be administered to one person at a time. It was pre-tested and adapted to the local scenario in a workshop where representatives from an academic institution, WHO-India and the health services were present. We added the options of *beedi, hukka* to the choices in tobacco use in the core behavioural measures as use of these substances was common in the study communities. The question on drinking alcohol was dropped for women as alcohol intake was negligible among them. It was considered culturally inappropriate for a male investigator to seek this information from women

respondents. The adapted questionnaire sought data on core sociodemographic characteristics (age, sex, education, religion and occupation) and core behavioural measures (self-reported tobacco use, dietary history and physical activity). Physical measurements (weight, height, blood pressure [BP], waist and hip circumference) were also done. The procedure for measuring waist and hip circumference was demonstrated to women subjects and measurements were done when the auxiliary nurse midwife (ANM) or lady health visitor (LHV) was present. Biochemical tests were not included because of resource constraints.

Data collection

The survey was done by one of the male investigators (SSK), who was trained to administer the questionnaire and carry out anthropometric and BP measurements. BP was recorded using a mercury sphygmomanometer on the right arm of each individual according to standard guidelines.[16] The first reading of BP was taken after 5 minutes of rest and the second reading was taken at the end of the interview, i.e. after 10 minutes, which was taken as the final reading for analysis.

The sphygmomanometer used for the study was compared with the sphygmomanometer at the hypertension clinic in the Department of Internal Medicine, PGIMER, Chandigarh. BP was measured in 15 patients with the help of both instruments. The technical error of measurement (TEM) for systolic BP and diastolic BP was 3.8 and 3.2 mmHg, respectively.[17,18] This exercise was also done to find the correctness in measurement of BP by the investigator. BP of 20 patients were measured by the physician at the hypertension clinic, and again by the investigator for the initial 10 patients, and for the remaining 10 patients this process was reversed with the investigator measuring the BP first. The TEM in estimation of SBP and DBP was 2.2 and 2.9 mmHg, respectively. Weight, height, waist and hip measurments of the subjects were done using a tape according to the protocol mentioned in the WHO CVD risk management package.[19] The same instruments were used throughout the survey.

Statistical analysis

Hypertension was defined as systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg. Those who were taking antihypertensive drugs at the time of the survey were also included in the hypertensive group. Waist-to-hip ratio of >0.9 and >0.85 were taken as the cut-offs for truncal obesity in men and women, respectively, using the WHO definition.[19] BMI was calculated using the formula: weight (kg)/height (m)^2 and those with a value ≥25 kg/m^2 were categorized as overweight. Current tobacco use was defined as subjects using tobacco either in the form of smoking, chewing or both, at least once a day for the past 1 month. The definition of urban and rural areas was based on the guidelines of the Registrar General and Census Commissioner of India.[20] Urban slum (where people in the lower socioeconomic strata live) was considered as a separate category during data analysis.

Education was chosen as a proxy for socioeconomic status as about 40% (158) of the respondents either did not reveal or said that they did not know their income. An attempt was made to find out the relationship between income and educational status among those who reported their income. The respondents were categorized into 3 income groups depending on their monthly household income; low (<Rs 1500), medium (Rs 1501–5000) and high (>Rs 5000). About half (51%) of these who were illiterate were in the low income group and only 5% belonged to the high income group.

Data were entered and analysed by Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta, USA) and SPSS version 11.0 software (SPSS Inc. SPSS for Windows, Ver 11.0.1, Chicago). Prevalence of risk factors is presented per 100 population. Statistically significant differences in the categorical and quantitative variables were tested by the chi-square and *t*-test, respectively. Logistic regression analysis was done to estimate the odds ratio and 95% confidence intervals of the risk factors in the urban area and among literates compared with the urban slum, rural area, and illiterates, respectively, after controlling for the effects of potential confounders (age, sex, literacy, place of residence, etc.). All significance tests were 2-tailed and statistical significance was defined as a value of p<0.05.

RESULTS

About three-fifths (63%) of the study subjects were women and about one-third (37%) were 30–39 years of age, a majority (84%) were Hindus and 44% reported that they had had no formal schooling (Table I).

The prevalence of tobacco use was more in the rural areas (41%) of Haryana. In slums of Chandigarh, sedentary activity (22%) and current alcohol intake (24%) were more prevalent than in urban and rural areas. The prevalence of overweight was high in the slums. However, the prevalence of central obesity and hypertension was similar in the three areas studied (Table II). The prevalence of CVD risk factors increased at higher ages and it was higher among men, except that physical inactivity was more common among women (Table II).

After adjusting for the effects of age, sex and place of residence, the prevalence risk ratio of smoking was significantly lower among literates (OR 0.3; 95% CI 0.1–0.8, p=0.01). The prevalence of current alcohol use, sedentary physical activity, central obesity, overweight and hypertension were similar among the literate and illiterate population (p>0.05, Table III).

DISCUSSION

Epidemiological transition progresses through several stages. Higher income groups are the first to be affected by CVDs. Later,

TABLE I. Sociodemographic characteristics of the study population

Characteristic	Urban *n*=100	Slum *n*=150	Rural *n*=150	Total *n*=400
Gender				
Men	34 (34.0)	57 (38.0)	58 (38.7)	149 (37.3)
Women	66 (66.0)	93 (62.0)	92 (61.3)	251 (62.7)
*Age group (years)**				
30–39	33 (33.0)	67 (44.7)	47 (31.3)	147 (36.8)
40–49	26 (26.0)	45 (30.0)	25 (16.7)	96 (24.0)
50–59	15 (15.0)	13 (8.7)	32 (21.3)	60 (15.0)
≥60	26 (26.0)	25 (16.7)	46 (30.7)	97 (24.3)
Religion†				
Hindu	79 (79.0)	129 (86.0)	126 (84.0)	334 (83.5)
Sikh	18 (18.0)	10 (6.7)	4 (2.7)	32 (8.0)
Muslim	3 (3.0)	9 (6.0)	20 (13.3)	32 (8.0)
Education†				
Literate	72 (72.0)	88 (58.7)	63 (42.0)	223 (55.8)
Illiterate	28 (28.0)	62 (41.3)	87 (58.0)	177 (44.3)
Occupation†				
Employee	13 (13.0)	35 (23.3)	6 (4.0)	54 (13.5)
Self-employed	12 (12.0)	35 (23.3)	42 (28.0)	89 (22.3)
Homemaker	51 (51.0)	67 (44.7)	84 (56.0)	202 (50.5)
Not working†	24 (24.0)	13 (8.7)	18 (12.0)	55 (13.8)

* p<0.01 † p<0.001 Values in parentheses are percentages

TABLE II. Prevalence (%) of risk factors for cardiovascular disease

Risk factors	Age (years)				Sex		Area		
	30–39 *n*=147	40–49 *n*=96	50–59 n=60	≥60 *n*=97	Men *n*=149	Women *n*=251	Urban n=100	Slum *n*=150	Rural *n*=150
Current tobacco users	14.0	30.0	35.0	41*	58.0	9.2*	17.0	21.0	41.0
Current alcohol intake	18.0	26.0	17.0	20.0	54.0	na	22.0	24.0	15.0
Sedentary activity	11.0	14.0	12.0	23.0	21.0	10.0†	11.0	22.0	9.3
Central obesity‡	86.0	89.0	93.0	92.0	94.0	86.0	89.0	93.0	85.0
Overweight (BMI≥25 kg/m^2)	20.0	16.0	20.0	22.0	15.0	22.0	20.0	27.0	11.0
Hypertension	16.0	36.0	52.0	52†	37.0	34.0	39.0	35.0	33.0

* p<0.001 † p<0.05 ‡ Waist–hip ratio >0.9 for males and >0.85 for females, na alcohol intake was not assessed among females

TABLE III. Prevalence (%) of risk factors for cardiovascular disease according to literacy

Risk factor	Literate *n*=223	Illiterate *n*=177	Adjusted OR (95% CI)	p value
Current tobacco users	27.0	28.0	0.3 (0.1–0.8)	0.01
Current alcohol intake	28.7	9.6	0.9 (0.4–2.1)	0.8
Sedentary activity	16.6	11.9	1.3 (0.7–2.5)	0.5
Central obesity*	90.0	88.0	1.2 (0.6–2.3)	0.7
Overweight (BMI≥25 kg/m^2)	19.7	19.2	1.2 (0.6–2.1)	0.6
Hypertension	34.1	36.2	1.3 (0.8–2.2)	0.4

* Waist–hip ratio >0.9 for males and >0.85 for females

as the epidemic expands with mass production and consumption of the mediators of risk factors, all social classes are affected. Finally, high income groups experience less disease as they respond to health information with lifestyle changes and access preventive healthcare, and the low income groups become the most vulnerable. Our study indicates that some communities in northern India have advanced to the second stage of epidemiological transition as the prevalence of most of the CVD risk factors was similar in various social groups (Tables II and III). The prevalence of hypertension was high in the study communities. Studies in different parts of India have shown a variable prevalence of hypertension in rural areas, ranging from 2.9% in 1989 to 33.3% in 2004.[21–24] These studies are not strictly comparable as different BP cut-off levels were used for defining hypertension, and there were differences in the age and sex structure of the study populations.

The association of socioeconomic status and CVDs in developing countries is not as consistent as in developed countries. Some studies have shown that socioeconomic status is inversely associated with the occurrence of CVDs and its risk factors,[10–13] whereas other studies reveal an opposite trend.[25,26] Studies from China have also reported that men with a low level of literacy are prone to unhealthy risk behaviours such as heavy cigarette smoking, alcohol consumption, obesity, physical inactivity and high BP.[27,28]

We found that the prevalence of most risk factors for CVDs in the rural population was similar to those in the urban population except for sedentary activity. The mortality data from a study in rural Andhra Pradesh also showed that chronic diseases including diseases related to the circulatory system and injuries were the leading causes of death in 45 villages in the East and West Godavari districts.[29] An inverse graded relationship of education with tobacco consumption and hypertension has been observed; however, no clear relationship has been identified for other risk factors.[10,11] A study among the industrial population across 10 sites of India showed a reversal of social gradient for tobacco use and hypertension.[12] A case–control study from a tertiary hospital showed a higher risk of myocardial infarction among the poor and less educated.[13]

The effects of globalization are evident even in rural areas of India where mechanization is present in most of the rural households. With increase in the availability of energy-rich foods coupled with a decrease in energy expenditure due to increased mechanization, people living in rural areas are likely to become more susceptible to the development of risk factors for CVDs.[1,2]

An important finding is a similar prevalence of risk factors for CVDs in the urban poor or slum population as in urban areas. About 28% of India's population lives in urban areas, and the slum population constitutes 21% of the total urban population.[30] The focus of the healthcare delivery system till recently was on developing a rural health system having a three-tier health delivery structure. Specific efforts were not made to create a well organized health service delivery structure for poor people living in the slums. With the increasing trend of CVD risk factors, the urban poor are likely to face a dual burden of disease.

Our study was done in a small geographical area and, hence, its results cannot be generalized to the whole of the region, but it indicates the need to assess the prevalence of risk factors for CVDs in the rural areas and urban slums of India. In the absence of good quality income data, we considered education as a proxy for socioeconomic status. Educational attainment has been reported to be a valid and easily measurable indicator of socioeconomic status and is considered suitable for social ranking across many populations at different stages of development.[12]

Although we used the WHO STEPS questionnaire, the recording of BP was not according to the STEPS criteria. This may not allow comparison of the prevalence of hypertension with other studies that have used the WHO STEPS methodology. However, comparison of the prevalence of hypertension across the groups studied remains valid as we used the same methodology in all the groups. Our study had a higher proportion of women (63%) as it was more difficult to contact male members of the household as some of them were working away from home. Hence, gender was included in the multivariate analysis so as to take care of any confounding effect that may arise due to the preponderance of women in the study.

REFERENCES

1 Omran AR. The epidemiologic transition. A theory of the epidemiology of population change. *Milbank Mem Fund Q* 1971;**49:**509–38.
2 Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: Part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. *Circulation* 2001;**104:**2746–53.
3 Murray CLJ, Lopez AD. *Global health statistics: Global burden of disease and injury series. Volumes 1 and 2*. Boston:Harvard School of Public Health; 1996.

4 Kumar R, Singh MC, Singh MC, Ahlawat SK, Thakur JS, Srivastava A, *et al*. Urbanization and coronary heart disease: A study of urban–rural differences in northern India. *Indian Heart J*. 2006;**58:**126–30.
5 Zachariah MG, Thankappan KR, Alex SC, Sarma PS, Vasan RS. Prevalence, correlates, awareness, treatment, and control of hypertension in a middle-aged urban population in Kerala. *Indian Heart J* 2003;**55:**245–51.
6 Shanthirani CS, Pradeepa R, Deepa R, Premalatha G, Saroja R, Mohan V. Prevalence and risk factors of hypertension in a selected South Indian population—the Chennai Urban Population Study. *J Assoc Physicians India* 2003;**51:**20–7.
7 Swami HM, Bhatia V, Gupta M, Bhatia SP, Sood A. Population based study of hypertension among the elderly in northern India. *Public Health* 2002;**116:**45–9.
8 Gupta R, Gupta VP, Sarna M, Bhatnagar S, Thanvi J, Sharma V, *et al*. Prevalence of coronary heart disease and risk factors in an urban Indian population: Jaipur Heart Watch-2. *Indian Heart J* 2002;**54:**59–66.
9 Sharma AK, Bhardwaj S, Chaturvedi S. Predictors of hypertension in an urban Indian population. *Indian Heart J* 2006;**58:**21–7.
10 Gupta R, Gupta VP, Ahluwalia NS. Educational status, coronary heart disease, and coronary risk factor prevalence in a rural population of India. *BMJ* 1994;**309:** 1332–6.
11 Gupta R, Gupta VP, Sarna M, Prakash H, Rastogi S, Gupta KD. Serial epidemiological surveys in an urban Indian population demonstrate increasing coronary risk factors among the lower socioeconomic strata. *J Assoc Physicians India* 2003;**51:**470–7.
12 Reddy KS, Prabhakaran D, Jeemon P, Thankappan KR, Joshi P, Chaturvedi V, *et al*. Educational status and cardiovascular risk profile in Indians. *Proc Natl Acad Sci U S A* 2007;**104:**16263–8.
13 Pais P, Pogue J, Gerstein H, Zachariah E, Savitha D, Jayprakash S, *et al*. Risk factors for acute myocardial infarction in Indians: A case–control study. *Lancet* 1996;**348:** 358–63.
14 Kar SS, Thakur JS, Jain S, Kumar R. Cardiovascular disease risk management in a primary health care setting of north India. *Indian Heart J* 2008;**60:**19–25.
15 STEPS instrument for NCD risk factors (core and expanded version 1.4). Geneva:Division of non-communicable diseases and mental health, WHO. Available at *http://www.afro.who.int/cdp/documents/steps_tools/instrument_core.pdf* (accessed on 10 March 2008).
16 Beevers G, Lip GY, O'Brien E. ABC of hypertension: BP measurement. Part II—conventional sphygmomanometry: Technique of auscultatory BP measurement. *BMJ* 2001;**322:**1043–7.
17 Adams C, Burke V, Beilin LJ. Accuracy of BP measurement and anthropometry among volunteer observers in a large community survey. *J Clin Epidemiol* 2002;**55:**338–44.
18 Ulijaszek SJ, Kerr DA. Anthropometric measurement error and the assessment of nutritional status. *Br J Nutr* 1999;**82:**165–77. Erratum in: *Br J Nutr* 2000;**83:**95.
19 World Health Organization. *CVD risk management package for low and medium resource settings*. Geneva:WHO; 2002.
20 Census of India. Office of the Registrar and Census Commissioner, India. Available at *http://www.censusindia.gov.in/Census_Data_2001/Census_data_finder/Census_Data_Finder.aspx* (accessed on 2 December 2008).
21 Malhotra P, Kumari S, Kumar R, Jain S, Sharma BK. Prevalence and determinants of hypertension in an un-industrialised rural population of North India. *J Hum Hypertens* 1999;**13:**467–72.
22 Gupta R, Prakash H, Gupta VP, Gupta KD. Prevalence and determinants of coronary heart disease in a rural population of India. *J Clin Epidemiol* 1997;**50:**203–9.
23 Wander GS, Khurana SB, Gulati R, Sachar RK, Gupta RK, Khurana S, *et al*. Epidemiology of coronary heart disease in a rural Punjab population—prevalence and correlation with various risk factors. *Indian Heart J* 1994;**46:**319–23.
24 Chadha SL, Gopinath N, Ramachandran K, Radhakrishnan S. Epidemiological study of hypertension in rural community of Gurgaon district (Haryana state). *Ann Natl Acad Med Sci (India)* 1989;**25:**141–50.
25 Wong SL, Donnan SP. Influence of socioeconomic status on cardiovascular diseases in Hong Kong. *J Epidemiol Community Health* 1992;**46:**148–50.
26 Hameed K, Kadir M, Gibson T, Sultana S, Fatima Z, Syed A. The frequency of known diabetes, hypertension and ischaemic heart disease in affluent and poor urban populations of Karachi, Pakistan. *Diabet Med* 1995;**12:**500–3.
27 Siegrist J, Bernhardt R, Feng ZC, Schettler G. Socioeconomic differences in cardiovascular risk factors in China. *Int J Epidemiol* 1990;**19:**905–10.
28 Yu Z, Nissinen A, Vartiainen E, Song G, Guo Z, Tian H. Changes in cardiovascular risk factors in different socioeconomic groups: Seven year trends in a Chinese urban population. *J Epidemiol Community Health* 2000;**54:**692–6.
29 Joshi R, Cardona M, Iyengar S, Sukumar A, Raju CR, Raju KR, *et al*. Chronic diseases now a leading cause of death in rural India—mortality data from the Andhra Pradesh Rural Health Initiative. *Int J Epidemiol* 2006;**35:**1522–9.
30 National Commission on Population. New Delhi:Ministry of Health and Family Welfare, Government of India; 2000.