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Prevalence of coronary artery disease and coronary risk factors in rural and urban populations of north India

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Objective This study was conducted to determine and compare the prevalence of coronary artery disease and coronary risk factors in both a rural and an urban population of Moradabad in north India.

Design and setting A cross-sectional survey of two randomly selected villages from the Moradabad district and 20 randomly selected streets in the city of Moradabad.

Subjects and methods The 3575 subjects were between 25 and 64 years old; 1769 (894 men and 875 women) lived in the countryside and 1806 (904 men and 902 women) lived in the city. The survey methods were questionnaires, physical examination and electrocardiography.

Results The overall prevalence of coronary artery disease, based on a clinical diagnosis and an electrocardiogram, was 9·0% in the urban and 3·3% in the rural population. The prevalences were significantly (P<0·001) higher in the men compared with the women in both urban (11·0 vs 6·9%) and rural (3·9 vs 2·6%) populations, respectively. The prevalence of symptomatic coronary artery disease (known coronary disease and Rose questionnaire-positive angina) was 2·3% in the men (n=19) and 1·5% in the women (n=13) in the rural subjects, and 8·5% in the men (n=77) and 3·4% in the women (n=31) in the urban population. When diagnosed on the basis of electrocardiographic changes alone, the prevalences were 1·5% (n=26) in the rural population and 3·0% (n=55) in the urban. Coronary risk factors were two- or three-fold more common among urban subjects compared to the rural population in both sexes. Central obesity was four times more common in the urban population compared to the rural in both sexes. Sedentary lifestyle and alcohol intake were significantly (P<0·01) higher in the urban population compared to the rural subjects. There was a significant association between coronary disease and age, hypercholesterolaemia, hypertension and central obesity in both sexes. Smoking was a significant risk factor of coronary disease in men.

Conclusions Coronary artery disease and coronary risk factors were two or three times higher among the urban compared with the rural subjects, which may be due to greater sedentary behaviour and alcohol intake among urbans. It is possible that some Indian populations can benefit by reducing serum cholesterol, blood pressure and central obesity and increasing physical activity.
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Key Words: Electrocardiographic, prevalence, risk factors, rural, urban, hypercholesterolaemia, central obesity.

Introduction

By the year 2015, cardiovascular diseases could be the most important cause of mortality in India[1,2]. The prevalence of coronary artery disease increased from 1% in 1960 to 9·6% in 1995 in urban populations, and in rural areas it has almost doubled in the last decade[2–9]. Studies from rural areas[3–5] have demonstrated a lower prevalence compared to studies[5–8] from urban areas. However, similar methods of sample selection and diagnosis criteria[5,9] were used in only a few studies. There are no large scale studies of adequate sample size to demonstrate differences in prevalence rate, risk factor patterns and electrocardiographic changes in the rural and urban populations of India. The increase in prevalence and the rural–urban differences in the prevalence of coronary artery disease indicate that differences in diet and lifestyle characteristics and conventional risk

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factors may be important[5,9]. The association between these characteristics and coronary artery disease risk factors may be easily demonstrated when two populations with different diets and lifestyles are compared using similar methods of sample selection and similar criteria of diagnosis[10–13]. In the present study, we describe the prevalence of coronary artery disease and coronary risk factors among random samples[14,15] of Indian rural and urban populations, using an adequate sample size and recently developed well defined investigation criteria.

Subjects and methods

The details of subjects and methods regarding both rural and urban samples[14,15] have been described. Briefly, the sampling frame for the urban subjects comprised the final population total of Moradabad city, which is roughly 0·43 million based on a 1991 census[16]. After excluding 16 suburban streets, 20 out of the remaining 180 streets were randomly selected by persons unconnected with the study. They blindly selected 20 cards from 180, each enclosed in a sealed envelope and each representing a street.

There are 68 villages in the Moradabad Tahsil each with a population of 1000–5000 subjects, of whom about 40% are adults. The total Tahsil population is about 0·1 million. After excluding six suburban villages, two villages were selected at random from the 62 remaining. We selected 40–100 adults from each street in the village, as well as from the city, by randomly selecting a card as described above.

The prevalence of coronary artery disease is at least 5% in the community[2–5]. A sample of at least 1500 subjects is needed to estimate with 90% confidence and 5% significance a relative risk of 1·54 for the prevalence of coronary artery disease in Indians[17]. We decided to select 2000 subjects to increase the level of confidence. Thus, with a sample of 2000 subjects from both rural and urban areas, we would be able to estimate the prevalence to within a 2% error on either side, which was deemed satisfactory as a first estimate.

We contacted 4015 subjects (2024 rural and 1991 urban) between 25 and 64 years of age. Of these subjects, 255 (12·6%) rural and 185 (9·3%) urban, chose not to participate. The remaining 1769 rural (894 males and 875 females) and 1806 urban subjects (904 males and 902 females) between 25 and 64 years, inclusive, (total n=3575) were selected for this study. Our preliminary study[5] from rural and urban populations showed similar response rates from both sexes. Detailed interviews were performed with the help of a pre-tested and validated questionnaire[5] prepared according to guidelines of the World Health Organization[17]. The questionnaire was filled in by a physician to record a detailed history of hypertension, diabetes, coronary artery disease, smoking, sedentary behaviour and alcohol intake. Sedentary behaviour was assessed by inquiring about work-related and spare time activities.

Blood pressure (systolic and diastolic phase V of Korotkoff) was measured in the right arm after 5 min rest in the sitting position, by a single standard mercury manometer and by the same physician in all subjects. A 12-lead electrocardiogram was recorded in all subjects. Body weights were measured by the health worker independently, with subjects in their under-clothes to the nearest 0·5 kg. Waist and hip girths were measured in the standing position. The waist was measured as the smallest horizontal girth between the costal margin and the iliac crests, and the hip as the greatest circumference at the level of greater trochanters.

Criteria for diagnosis

Hypertension was diagnosed[18] when the systolic blood pressure was 140 mmHg or more and the diastolic blood pressure 90 mmHg or more, as per guidelines of other agencies[18]. Figures for WHO criteria for the diagnosis of hypertension (>160/95 mmHg) are also given. Body mass index was calculated and obesity defined as a body mass index of >27 kg . m^{-2} and overweight, as a body mass index >25 kg . m^{-2}. Figures for criteria laid down by the Indian consensus group[18] for overweight (>23 kg . m^{-2}) were also calculated. Central obesity was diagnosed in the presence of a waist–hip ratio >0·88 in males, and >0·85 in females, as suggested in previous studies[5,18].

Hypercholesterolaemia[18] was diagnosed in the presence of serum cholesterol >5·18 mmol . l^{-1} (>200 mg . dl^{-1}) and hypertriglyceridaemia in the presence of serum triglyceride >2·08 (>185 mg . dl^{-1}). Diabetes mellitus was diagnosed in the presence of fasting blood glucose >7·7 mmol . l^{-1} (>140 mg . dl^{-1}) and postprandial 2 h after 75 g of oral glucose >11·1 mmol . l^{-1} (>200 mg . dl^{-1}). Postprandial blood glucose between 7·7 and 11·1 mmol . l^{-1} (140–200 mg . dl^{-1}) was considered glucose intolerance. We categorized users of any form of tobacco together with former smokers, as smokers, as was done in previous studies[7]. Individuals who admitted to ingesting alcohol once a week were categorized as alcohol consuming.

According to the Indian consensus Group[16,18] a person is considered to have a sedentary behaviour if he walks less than 14·5 km a week, climbs fewer than 20 flights of stairs a week or preforms no moderate physical activity (300 Kcal . day^{-1}) on 5 days a week.

The criteria for the diagnosis of coronary artery disease[17] were: (a) a history of angina or infarction and previously diagnosed disease (b) an affirmative response to the Rose questionnaire and (c) electrocardiographic findings, namely Minnesota codes 1-1, 4-1, 5-9, 5-2 or 9-2. The presence of all three criteria was taken as confirmation of the diagnosis of coronary artery disease. Individual clinical criteria, such as known coronary artery disease, an affirmative response to the Rose questionnaire and electrocardiographic changes (Q wave changes, codes 1-1 and 1-2, ST segment depression or elevation codes 4-1, 4-2 and 9-2 and T wave inversions, codes 5-1 and 5-2) were also recorded.

Table 1 Prevalence of coronary artery disease by age and sex in rural and urban subjects. Values are n (%)

Age groups (years)	Men				Women			
	Rural		Urban		Rural		Urban	
	Number of subjects	Coronary artery disease	Number of subjects	Coronary artery disease	Number of subjects	Coronary artery disease	Number of subjects	Coronary artery disease
25–34	300	8 (2·6)	304	25 (8·2)	350	5 (1·4)	354	15 (4·2)
35–44	296	12 (4·0)	290	36 (12·4)	264	6 (2·2)	254	15 (5·9)
45–54	178	9 (5·0)	182	23 (12·6)	165	7 (4·2)	171	18 (10·5)
55–64	120	6 (5·0)	128	16 (12·5)	96	5 (5·2)	123	15 (12·1)
Total	894	35 (3·9)	904	100 (11·0)*	875	23 (2·6)	902	63 (6 98)*
Total between 45 and 64 years	298	15 (5·0)	310	39 (12·5)	261	12 (4·5)	294	33 (11·2)

*P<0·001.

The prevalence of coronary artery disease has also been classified, based on a clinical diagnosis of myocardial infarction or angina pectoris, according to the criteria of the cardiovascular Health Study[19]. Myocardial infarction was classified into (i) definite, in the presence of a past history confirmed by examining a record of previous electrocardiograms and other tests using World Health Organization[17] criteria or in the presence of characteristic Q waves in the anterior or inferior leads of surveyed electrocardiograms, (ii) unreported, when there were Q waves in the anterior or inferior leads in the absence of past history, and (iii) possible, in the presence of significant Q waves in >2 leads. Angina was diagnosed as (i) definite, in the presence of: a past history confirmed by examination of previous electrocardiograms, results of stress tests or coronary angiograms, or documented electrocardiographic changes of >1 mm horizontal or downsloping ST segment depression in anterior or inferior leads during episodes of chest pain (ii) unreported, when more than 1 mm of horizontal or down sloping ST segment depression in the anterior or inferior leads was observed in the electrocardiogram in the absence of a history of angina, and (iii) possible, when T wave changes were present in the absence of angina or ST segment changes. All subjects were classified accordingly.

The prevalence of coronary artery disease was also classified according to the presence or absence of symptoms[17,19]. Those who knew they had the disease or showed an affirmative response to the Rose questionnaire were classified as symptomatic patients.

Laboratory data

A fasting blood sample after an overnight fast was obtained from all the subjects. Total cholesterol and triglyceride levels were estimated by an enzymatic method. The concentration of high density lipoprotein cholesterol was obtained after precipitation of non-high density lipoprotein cholesterol. The concentration of low density lipoprotein cholesterol was by calculation. Each participant was asked to drink 75 g anhydrous glucose in 200 ml of water and a second blood sample was collected after 2 h for analysis of glucose.

Statistical analysis

The prevalence rates are given in percent and numerical variables as mean plus or minus 1 standard deviation (mean ± SD). The significance of association of various risk factors was determined by regression analysis wherein odds ratios and 95% confidence intervals were calculated by univariate and multivariate analysis using overall coronary artery disease prevalence as the dependent variable.

Results

The overall prevalence of coronary artery disease was significantly (P<0·001) higher in the urban compared to the rural subjects (9·0 vs 3·27%). The sex of the subject made no difference. The prevalence was approximately three times higher in the urban compared to the rural subjects in both men (11·0 vs 3·9%, P<0·001) and women (6·98 vs 2·6%, P<0·001) and the rates increased as subjects grew older (Table 1).

The prevalence of coronary artery disease known to patients was 1·0% in men and 0·68% in women in the rural population and 3·6% in men and 2·3% in women in the urban subjects. The prevalence of Rose-questionnaire positive angina was 1·3% in men and 1·1% in women in the rural population and 3·7% in men and 1·1% in women in the urban. Thus, the prevalence of symptomatic coronary artery disease (known coronary artery disease and Rose-questionnaire positive angina) was 2·3% in men (n=21) and 1·48% in women (n=13) in the rural subjects (P<0·05) and 8·5% in men (n=77) and 3·4% in women (n=31) in the urban population (P<0·001) (Tables 1 and 2).

The prevalence of Q waves was 0·89% in men and 0·46% in women in the rural population and 6·6% in men and 1·8% in women in the urban. ST-T changes or combined ST-T plus Q wave changes were also

Table 2 Prevalence of coronary artery disease (%)

Age groups (years)	n	Clinical with (known+Rose questionnaire)	Electrocardiographic (silent CAD)	Total	n	Clinical with (known+Rose questionnaire)	Electrocardiographic (silent CAD)	Total
	Rural — men				Urban — men			
25–34	300	3 (0·99)	5 (1·6)	8 (2·6)	304	18 (5·9)	7 (2·3)	25 (8·2)
35–44	296	5 (1·68)	7 (2·3)	12 (3·9)	290	24 (8·2)	12 (4·1)	36 (12·3)
45–54	178	6 (3·3)	3 (1·7)	9 (5·1)	182	22 (12·0)	1 (0·55)	23 (12·5)
55–64	120	5 (4·1)	1 (0·8)	6 (5·0)	128	13 (10·1)	3 (2·3)	16 (12·4)
Total	894	19 (2·3)	16 (1·8)	35 (3·9)	904	77 (8·52)	23 (2·5)	100 (11·06)
Chi-square trend		32·63	6·42	20·41		44·65	15·85	25·44
P value		<0·01	<0·05	<0·02		<0·001	<0·005	0·001
	Rural — women				Urban — women			
25–34	350	3 (0·84)	2 (0·56)	5 (1·4)	354	3 (0·8)	12 (3·4)	15 (4·2)
35–44	264	3 (1·13)	3 (1·13)	6 (2·2)	254	7 (2·7)	8 (3·1)	15 (5·9)
45–54	165	5 (3·0)	2 (1·2)	7 (4·2)	171	12 (7·0)	6 (3·5)	18 (10·5)
55–64	96	2 (2·0)	3 (3·1)	5 (5·2)	123	9 (7·3)	6 (4·8)	15 (12·2)
Total	875	13 (1·48)	10 (1·14)	23 (2·6)	902	31 (3·4)	32 (3·4)	63 (6·98)
Chi-square trend		9·65	12·25	12·67		12·86	5·88	8·64
P value		<0·05	<0·02	<0·01		<0·01	0·02	0·001
Total Men+Women	1769	32 (1·8)	26 (1·47)	58 (3·28)	1806	108 (5·98)	55 (3·04)	163 (9·02)

CAD=Coronary artery disease, values are number (percentage).

Table 3 Prevalence of different types of coronary artery disease based on new criteria in rural and urban populations

Type	Rural n (%) Men (n=894) Total	25–34 (n=300)	35–44 (n=296)	45–54 (n=178)	55–64 (n=120)	Women (n=875) Total	25–34 (n=350)	35–44 (n=264)	45–54 (n=165)	55–64 (n=96)
Myocardial infarction										
Definite	4 (0·45)	—	1 (0·34)	1 (0·5)	2 (1·6)	2 (0·23)	—	—	1 (0·6)	1 (1·0)
Unreported	5 (0·56)	2 (0·66)	1 (0·34)	2 (1·1)	—	4 (0·46)	1 (0·28)	2 (0·75)	1 (0·6)	—
Possible	3 (0·33)	1 (0·33)	1 (0·34)	—	1 (0·8)	2 (0·23)	1 (0·28)	—	1 (0·6)	—
Total	12 (1·34)*	3 (1·0)	3 (1·01)	3 (1·7)	3 (2·5)	8 (0·92)	2 (0·56)	2 (0 75)	3 (1·8)	1 (1·0)
Angina pectoris										
Definite	4 (0·45)	1 (0·33)	2 (0·68)	—	1 (0·8)	2 (0·23)	—	1 (0·38)	1 (0·6)	—
Unreported	5 (0·56)	2 (0 66)	1 (0·34)	2 (1·1)	—	4 (0·46)	1 (0·28)	1 (0·38)	1 (0·6)	1 (1·0)
Possible	14 (1·56)	2 (0·66)	6 (2·02)	4 (2·2)	2 (1·6)	9 (1·03)	2 (0·56)	2 (0·75)	2 (1·2)	3 (3·1)
Total	23 (2·57)*	5 (1·6)	9 (3·04)	6 (3·4)	3 (2·5)	15 (1·7)	3 (0·84)	4 (1·5)	4 (2·4)	4 (4·1)
Total cases	35 (3·9)									
Type	**Urban n (%) Men (n=904) Total**	**(n=304)**	**(n=290)**	**(n=182)**	**(n=128)**	**Women (n=902) Total**	**(n=354)**	**(n=254)**	**(n=171)**	**(n=123)**
Myocardial Infarction										
Definite	8 (0·88)	2 (0·65)	3 (1·03)	2 (1·1)	1 (0·78)	2 (0·22)	—	1 (0·39)	1 (0·58)	—
Unreported	15 (1·66)	4 (1·3)	7 (2·41)	3 (1·3)	1 (0·78)	16 (1·8)	3 (0·84)	5 (1·9)	6 (3·5)	2 (1·6)
Possible	8 (0·88)	2 (0·65)	3 (1·03)	2 (1·1)	1 (0·78)	2 (0·22)	2 (0·56)	—	—	—
Total	31 (3·4)†	8 (2·6)	13 (4·5)	7 (3·8)	3 (2·34)	20 (2·2)	5 (1·1)	6 (2·4)	7 (4·09)	2 (1·6)
Angina pectoris										
Definite	16 (1·76)	3 (0·98)	4 (1·38)	5 (2·7)	4 (3·12)	9 (1·0)	2 (0·56)	2 (0·80)	3 (1·7)	2 (1·6)
Unreported	14 (1·55)	3 (0·98)	3 (1 03)	5 (2·7)	3 (2·34)	8 (0·9)	2 (0·56)	1 (0·39)	3 (1·7)	2 (1·6)
Possible	39 (4·3)	11 (3·6)	16 (5·52)	6 (3·3)	6 (4·68)	26 (2·9)	6 (1·68)	6 (2·3)	5 (2·9)	9 (7·3)
Total	69 (7·6)†	17 (5·6)	23 (7·9)	16 (8·8)	13 (10·1)	43 (4·77)	10 (2·2)	9 (3·5)	11 (6·4)	13 (10·5)
Total cases	100 (11·0)					63 (6·98)				

*$P<0·05$; †$P<0·02$.

significantly ($P<0·05$) higher in urban compared to rural subjects (Table 2). When the prevalence of coronary artery disease known to patients was combined with electrocardiographic changes, the rates were 3·9% in men and 2·6% in women in the rural population and 11·0% in men and 6·9% in women in the urban. The rural–urban differences in both sexes was significant ($P<0·001$).

According to the classification of the Cardiovascular Health Study[19] (Table 3), the prevalence of myocardial infarction (past documentation or symptomatic and asymptomatic Q waves) were significantly higher in men than women in the rural population (1·34 vs 0·92%, $P<0·05$) as well as in the urban population (3·4 vs 2·2%, $P<0·02$). The prevalence of total cases of angina were significantly higher in men than women in the rural subjects (2·6 vs 1·7, $P<0·05$) as well as in the urban population (7·6 vs 4·8%, $P<0·02$).

While the prevalence of smoking was significantly ($P<0·05$) higher in the rural than in the urban men, the prevalence of all other risk factors was significantly higher in urban subjects (Table 4). The prevalence of alcohol intake was significantly higher in urban men (10·4 vs 3·0%, $P<0·01$) compared to rural men. Alcohol intake is uncommon in women in India.

The prevalence of sedentary behaviour was significantly ($P<0·01$) higher in patients with coronary artery disease compared to subjects without coronary artery disease among rural (94·2 vs 10·8%) and urban (95·0 vs 48·9%) men, as well as rural (95·6 vs 47·6%) and urban (95·2 vs 56·6%) women, respectively.

Multivariate logistic regression analysis was done wherein odds ratios and 95% confidence intervals were calculated before and after adjustment for age in the regression equation (Table 5). The significant univariate associations between coronary risk factors and the prevalence of coronary artery disease were age, hypercholesterolaemia and hypertension in both men and women among rural and urban subjects. Smoking was a risk factor in both rural and urban men but not in women. Obesity was a risk factor in urban men. Central obesity was associated with coronary artery disease in rural and urban men and urban women. Central obesity was not the risk factor of coronary artery disease in rural women (Table 5).

Discussion

The present study shows that the prevalence of coronary artery disease is 9·0% in the urban and 3·3% in the rural

Table 4 Prevalence of risk factors in rural and urban subjects

Risk factors	Men		Women		Total	
	Rural (n=894)	Urban (n=904)	Rural (n=875)	Urban (n=902)	Rural (n=1769)	Urban (n=1806)
			n (%)			
Smoking	300 (33·5)*	249 (27·5)	51 (5·8)	105 (11·6)*	351 (19·8)	354 (19·6)
Hypercholesterolaemia						
(>200 mg . dl^{-1})	92 (10·2)	302 (33)**	87 (9·9)	306 (34)**	179 (10·1)	608 (34)
(>170 mg . dl^{-1})	265 (29·6)	692 (76·5)**	260 (29·7)	700 (77·6)**	525 (29·6)	1392 (77)**
Hypertriglyceridaemia						
(>185 mg . dl^{-1})	88 (9·8)	194 (21)*	85 (9·7)	202 (22)*	173 (9·8)	396 (22)*
Low/high density lipoprotein cholesterol						
(<35 mg . dl^{-1})	72 (8·0)	105 (12)*	54 (6·2)	65 (7)	126 (7·1)	170 (9)*
Hypertension (mmHg)						
>160/95	45 (5·0)	125 (13)*	36 (4·1)	117 (13)**	81 (4·6)	242 (13)**
>140/90	205 (22·9)	226 (25)	198 (22·6)	202 (22)	403 (22·8)	428 (24)
Diabetes mellitus	27 (3·0)	63 (7)*	24 (2·7)	45 (5)*	51 (2·9)	108 (6)*
Obesity (kg . m^{-2})						
>27	45 (5·0)	95 (10)*	46 (5·2)	120 (13)*	91 (5·1)	215 (12)*
>25	96 (10·7)	192 (21)*	100 (11·4)	300 (33·2)**	196 (11·0)	492 (27·2)*
>23	212 (27·7)	315 (34·8)*	220 (25·1)	414 (45·9)*	432 (24·4)	729 (40·3)*
Central obesity (waist–hip ratio)						
(>0·85 female, >0·88 male)	90 (10·0)	370 (41)**	125 (14·3)	504 (56)**	215 (12·1)	874 (48·4)**

*P<0·05; **P<0·001. P value obtained by comparison of rural with urban subjects.

Table 5 Association between coronary artery disease and coronary risk factors after adjustment for age by logistic regression analysis

Risk factors	Men		Women	
	Rural Odds ratio (95% CI)	Urban Odds ratio (95% CI)	Rural Odds ratio (95% CI)	Urban Odds ratio (95% CI)
Age	1·48 (1·27–1·67)**	1·52 (1·32–1·76)**	1·26 (1·07–1·47)*	1·32 (1·12–1·56)*
Smoking	1·25 (0·88–1·89)*	1·28 (0·92–1·92)*	0·96 (0·62–1·42)	0·99 (0·72–1·36)
Hypercholesterolaemia	1·36 (1·30–1·51)*	0·93 (0·82–0·98)*	1·22 (1·14–1·38)*	0·91 (0·85–0·97)*
Hypertension	1·31 (1·25–1·40)*	0·92 (0·80–0·99)*	1·27 (1·20–1·38)*	0·58 (0·47–0·68)*
Diabetes mellitus	0·82 (0·56–1·51)	0·85 (0·62–1·44)	0·88 (0·45–1·45)	0·82 (0·54–1·32)
Obesity	1·06 (0·95–1·10)	1·25 (1·12–1·38)*	1·01 (0·88–1·06)	1·25 (1·08–1·38)
Central obesity	1·35 (1·26–1·48)*	1·28 (1·21–1·39)*	0·92 (0·66–1·32)	1·28 (1·21–1·38)*

*P<0·05; **P<0·01.

populations and the rates are significantly higher in men compared to women in both urban (11·0 vs 7·0%) and rural (3·9 vs 2·6%) populations of north India, respectively. Coronary risk factors such as hypertension, hypercholesterolaemia, diabetes mellitus, obesity, central obesity and sedentary lifestyle were highly prevalent in the urban subjects, and they were 2 or 3 times less common among rural subjects. Significant associations of coronary artery disease were age, hypertension and hypercholesterolaemia. Smoking was a risk factor for coronary artery disease among rural and urban men.

The prevalence of coronary artery disease in the urban population of our study was higher than in reported urban studies from Chandigarh (6·6%)[20], Rohtak (3·8%)[9] and Jaipur (7·6%)[7] but lower than the Delhi survey (9·7%)[21] and Trivandrum (13·9%)[6]. Among rural subjects, the prevalence rate was higher than earlier rural studies[9] (1·7%) but comparable with Jaipur (3·5%)[3] and Ludhiana[4] (3·08%) and lower than a suburban village near Trivandrum (7·4%)[22]. Since earlier studies used an old version of the Rose questionnaire[9,20] and Epstein's electrocardiographic criteria for the diagnosis of coronary artery disease[9,20,22], these results are not comparable with the present study. However, it is clear[2] from different studies that the prevalence of coronary artery disease has almost doubled in the rural areas and increased nine-fold in the urban populations, and that the rates are higher in South India compared to the north[6–9,20–22]. In the Delhi survey[21], the investigators studied 13 275 subjects, initially diagnosed with coronary artery disease according to a documented history in 438 (3·2%), and then recorded electrocardiograms in 5621 (42·3%) of the 13 285 remaining subjects. The prevalence rate of 9·7% (1327 out of 13 275) was arrived at after extrapolation of the electrocardiographic findings to the 7664 subjects who did not undergo this test. In this study[21], alternate subjects were unable to undergo electrocardiography, which may have influenced the diagnosis and prevalence of coronary artery disease. For this reason, the results of this largest study[21] from India are also not comparable to our study.

Gupta *et al.*[7] studied 2212 subjects >20 years old in Jaipur and reported a 3·2% prevalence of symptomatic coronary artery disease (known coronary artery disease plus Rose-positive angina) which is similar to the Delhi survey[21] (3·2%) but lower than urbans (5·4%) in the present study. Among rural subjects, the prevalence of symptomatic coronary artery disease was lower (1·8%), which is comparable with other studies from rural areas[3,4]. The higher prevalence of asymptomatic/unreported infarction and angina pectoris in both sexes in our study appears to be due to illiteracy and ignorance about heart attacks in Indians. Economic status may also not allow them to approach a cardiologist for diagnosis and treatment.

In developed countries, no rural–urban differences exist in the prevalence of coronary artery disease and coronary risk factors[23]. The prevalence of coronary artery disease was approximately 10% between 25 and 64 years of age in most of the developed countries, which may be slightly higher in United States and north Europe and lower in southern Europe, Japan and Australia[10,13,19,23]. The Seven Countries Study[24] showed that the force of a risk factor may vary from one population to another, which may be explained by the presence of possible protective factors, such as physical activity, and adverse factors such as dietary saturated fat and antioxidant deficiency. There was a higher prevalence of risk factors in urbans compared to rural subjects, but the prevalence is not as great as in developed countries, although coronary artery disease prevalence is comparable. It is possible that the force of a conventional risk factor is greater in Indian urbans due to a sedentary lifestyle, a higher intake of dietary trans fatty acids and Indian ghee as well as genetic predisposition and insulin resistance[5,11].

The prevalence of coronary artery disease based on electrocardiographic criteria (Q+ST − T changes) in the present study was 1·5% in rural and 3·0% in urban subjects. Among urbans, these rates are comparable to studies from Chandigarh[20], Rohtak[9] and Jaipur[7], but lower than Delhi[21]. These findings further suggest a regional variation in the prevalence of coronary artery disease in Indians. It is possible that our ongoing five city study in Bombay, Calcutta, Nagpur, Trivandrum and Moradabad from the five regions of India, would provide more evidence regarding variations in prevalence and risk factors of coronary artery disease in different population groups.

Although the prevalence of smoking was higher among rural compared to urban men, the prevalence of coronary artery disease was higher in urbans. The exact cause of a higher smoking prevalence but a lower prevalence of coronary artery disease is not known. It seems that the adverse effect of smoking increases when dietary fat intake and serum cholesterol levels are also higher[10,11]. The association between hypercholesterolaemia and hypertension with coronary artery disease observed in our rural and urban subjects has also been reported by other workers[4–8]. Our pilot study in 152 urban and 162 rural subjects, and a study from Rohtak[9] of 750 urban and 1504 rural subjects also showed a higher prevalence of coronary artery disease and coronary risk factors, including insulin levels, in urbans compared to rural subjects. However, a few studies in Indian immigrants and Indian urbans showed that the consumption of dietary fat was higher compared to rural subjects in association with insulin resistance[1,10,11]. Urbans also consume higher trans fatty acids, which may have an adverse effect on lipoprotein(a) and on insulin resistance. This may predispose a subject to coronary artery disease even at relatively lower levels of conventional risk factors[14,18]. Higher physical activity observed in rurals, together with low occupational stress and a low fat diet common in rural India may also be possible protective factors for the lower risk of the rural population[18]. Further analysis of our data and more studies in different parts of India are urgently needed to demonstrate whether such differences in coronary artery disease prevalence also exist in other parts of India.

In conclusion, the findings of our study indicate that coronary artery disease and coronary risk factors have become a major public health problem in India and that the risk is 2–3 times greater in urban compared to rural subjects. It is possible that increased physical activity, and decreased serum cholesterol, blood pressure and obesity may help prevent coronary artery disease in Indians.

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