Original Article

Socioeconomic status and the prevalence of coronary heart disease risk factors

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South Asian countries have a high prevalence of coronary heart disease (CHD) in line with their economic development. India, in particular, has a high burden of CHD. Hence, the aim of the present study was to assess the prevalence of CHD risk factors in a semiurban population of Andhra Pradesh, India, in different socioeconomic status (SES) groups. Information was collected on socioeconomic status, physical activity, cigarette smoking, body mass, blood pressure (BP) and serum lipid profiles among a healthy sample of 440 men and 210 women with an age range of 20–70 years. Mean levels of serum cholesterol (SC), high density lipoprotein cholesterol (HDLC), low density lipoprotein cholesterol (LDLC) and skinfold ratio were found to be higher among women, whereas triglycerides (TG), systolic BP and diastolic BP were higher in men. No statistically significant differences in body mass index (BMI) or pulse rate were observed between the sexes. In men, a significant positive rank correlation (rho = $P < 0.05$) was observed between SES and SC, TG, systolic and diastolic BP, pulse rate and BMI, but in women, the same trend was found only with SC, TG, skinfold ratio and age. The prevalence (age standardized to the world population of Segi, 95% CI) of obesity was 14.37% (11.06–17.68), hypertension 13.13% (9.11–17.15), hypercholesterolemia 18.56% (13.88–23.24), hypertriglyceridemia 45.98% (36.47–55.49) and low HDLC 31.01% (24.25–37.77). In both sexes, the prevalence of hypercholesterolemia, hypertriglyceridemia and sedentary life style increased among higher SES groups ($P < 0.05$). Also, an increase in the level of social class was positively associated with mean levels of serum cholesterol and triglycerides in both men and women. The results demonstrate that higher SES groups have greater prevalence of CHD risk factors than lower SES groups. Preventive measures are required to reduce the risk factors among higher SES groups.

Key words: Andhra Pradesh, coronary heart disease, India, lipid profile, physical activity, socioeconomic status, Tirupati.

Introduction

Heart disease is a significant public health problem that can no longer be disregarded.[1] Coronary heart disease (CHD) rates among the major causes of mortality in developed countries and is rapidly becoming so in developing countries.[2,3] It has been predicted that cardiovascular diseases will be the most important cause of mortality in India by the year 2015.[4] An increasing number of developing nations are acquiring atherogenic lifestyles which include the adoption of atherogenic dietary habits similar to those seen in industrialised societies. This appears to be consistent with economic development.[5]

Major coronary risk factors are smoking, hypertension, dislipidemia, diabetes and obesity. Other factors that are considered to be important are fat distribution, family history of premature CHD and lifestyle risk factors.[6] The World Health Organization has recommended the development of national programs for the prevention and control of CHD through the simultaneous adoption of several strategies.[7] Thus, examination of the current levels of population risk factors is required.

Several studies in developing countries suggest that coronary risk factors may be related to socioeconomic status and urbanisation.[8,9] For example, the prevalence of CHD, diabetes, hypertension and obesity have increased 10-fold among urban dwellers in India.[10] Studies from rural areas have shown a lower prevalence of CHD compared to urban areas, but an increasing trend is seen among them as well.[11] Epidemiological studies are needed in each region of India to provide baseline data against which future trends in risk factor levels can be assessed and preventive strategies planned. The present study was therefore aimed at assessing the prevalence of CHD risk factors in different socioeconomic classes from a semiurban population of South India.

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Materials and methods

The study was designed to investigate a random sample of people from all social strata in Tirupati town in the state of Andhra Pradesh, India. Randomly chosen wards from different regions of the town were identified so as to include the different socioeconomic groups. Details of the population in these wards were available from the voters' list. The voters' list provides the names of all individuals who are 18 years and above. Only individuals aged 20 years and above were included in the sample. The objectives of the study were explained to all of the subjects before their consent was given. Out of 1500 selected subjects (800 men and 700 women), 440 men and 210 women agreed to participate in the study. The age range of the sample was between 20 and 70 years. Information on age, sex, socioeconomic status, physical activity and tobacco smoking was recorded.

Socioeconomic status (SES) was classified into five groups (i.e. I–V) according to Singh *et al.*,[12] based on scores of education, occupation, housing condition, ownership of durables and per capita income of the family. Group I was the highest and V the lowest SES class. Physical activity was assessed from occupational and spare time activities and subjects were graded as sedentary, mild, moderate or heavy, based on scores of activities according to Indian criteria.[12] The physical assessment included height, weight, triceps and subscapular skinfold measurements, as specified by Reddy *et al.*[13] Body mass index (BMI) was calculated as weight in kg/height in metre^2 (kg/m^2). Obesity was defined as BMI > 25.[13] Skinfold ratio was calculated as subscapular skinfold thickness/triceps skinfold thickness. Blood pressure was measured at the study site with a random zero mudler sphygmomanometer, as per the procedure of Rose *et al.*[14] Hypertension was diagnosed when the systolic blood pressure was > 140 mmHg or the diastolic blood pressure was > 90 mmHg, as per the guidelines prescribed by the joint national committee on detection, evaluation and treatment of high blood pressure.[15] Pulse rate was measured by palpitation of the radial artery at the wrist. The number of beats occurring in 30 s was counted and doubled to give the pulse rate per minute.

Fasting venous blood was collected in the morning from all subjects and the serum was separated from the whole blood. Serum cholesterol, high density lipoprotein cholesterol and triglycerides were estimated by enzymatic methods. The level of low density lipoprotein cholesterol was calculated according to the formula of Freidwald *et al.*[16] Hypercholesterolemia was defined as the total cholesterol > 200 mg% and hypertriglyceridemia as triglycerides > 120 mg%. Low high density lipoprotein cholesterol was defined as HDLC < 35 mg%.[17]

Statistical analysis was carried out via SPSS – 6.0 and alpha levels were set at $P < 0.05$. The prevalence of risk factors were given in percentages and the Mantel–Haenzel χ^2-test for linear association was applied to examine the statistical significance of trends across various SES groups. The risk factor levels in the SES groups were compared via one way ANOVA. Spearman coefficients of rank correlation (rho) were calculated between SES and the coronary risk factors. Age specific rates were calculated and standardisation performed by the direct method against the standard world population of Segi[18] and the results were expressed as age standardized rates with 95% confidence intervals.

Results

The sample distribution of the SES groups for men and women is presented in Table 1. The sample shows a broadly uniform distribution of percentages with some minor fluctuations across the SES groups. Table 2 shows the mean levels of dislipidemia, blood pressure, body mass index and skinfold thickness for men and women. Serum cholesterol, high density lipoprotein cholesterol (HDLC), low density lipoprotein cholesterol (LDLC) and skinfold ratio were found to be higher among women, whereas triglycerides and blood pressure (systolic and diastolic) were higher in men. No statistically significant differences were observed between the sexes in pulse rate or BMI. In men, significant positive rank correlations were found between SES levels and serum cholesterol (SC), triglycerides (TG), systolic blood pressure (BP), diastolic BP, pulse rate and BMI. On the other hand, in women, significant rank correlations were observed only with serum cholesterol, HDLC, TG, skinfold ratio and age. The larger Spearman rank correlations among women than men could be explained due to higher effects of SES.

Greater prevalence of hypercholesterolemia, sedentary lifestyle indices and obesity were recorded in women, while hypertriglyceridemia, low HDLC and hypertension were more prevalent in men (Table 3). Fifty three percent of the men were cigarette smokers but none of the women smoked. Age standardized CHD prevalence rates for the whole sample (Table 4) were as follows: hypercholesterolemia, 18.56% (13.88–23.24); hypertriglyceridemia, 45.98% (36.47–55.49); low HDLC, 31.01% (24.25–37.77); hypertension, 13.13% (9.11–17.15); obesity, 14.37% (11.06–17.68).

Increases in the prevalence of hypercholesterolemia, hypertriglyceridemia and leisure time physical activity in

Table 1. Distribution of subjects from Tirupati, India, according to socioeconomic status

Sex	Total	Group I		Group II		Group III		Group IV		Group V	
	n	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Men	440	102	23.18	118	26.82	52	11.82	96	21.82	72	16.36
Women	210	45	21.43	42	20.00	27	12.86	57	27.14	39	18.57
Total	650	147	22.62	160	24.62	79	12.15	153	23.54	111	17.08

Table 2. Metabolic and anthropometric measurements and their correlation with socioeconomic status in men and women (Spearman's rank correlation)

Parameter	Men		Women	
	Mean ± SD	Rho	Mean ± SD	Rho
Serum cholesterol (mg%)	159.00 ± 39.74	0.19*	179.78 ± 40.21	0.40*
HDLC (mg%)	40.12 ± 12.58	0.17	48.40 ± 16.59	0.51*
LDLC (mg%)	90.19 ± 32.48	0.10	114.50 ± 40.79	0.11
Triglycerides (mg%)	131.42 ± 51.12	0.28*	103.19 ± 35.22	0.53*
Systolic blood pressure (mmHg)	125.18 ± 12.07	0.19*	116.57 ± 17.81	0.13
Diastolic blood pressure (mmHg)	81.30 ± 7.89	0.19*	77.39 ± 8.53	0.05
Pulse rate (beats/min)	79.16 ± 5.93	0.14*	79.02 ± 6.71	0.07
Body mass index (kg/m^2)	21.55 ± 3.17	0.36*	21.72 ± 2.89	0.10
Skinfold ratio	1.39 ± 0.42	0.11	1.47 ± 0.52	0.25*
Age (years)	37.30 ± 10.79	0.12	34.43 ± 14.62	0.51*

Statistical significance (Spearman's rank correlation): *$P < 0.05$. HDLC, high density lipoprotein cholesterol; LDLC, low density lipoprotein cholesterol.

Table 3. Percentage prevalence of risk factors

Risk factor	Men		Women		Total	
	n	%	*n*	%	*n*	%
Hypercholesterolemia	54	15.08	45	30.61	99	19.60
Hypertriglyceridemia	132	57.39	30	27.02	162	47.51
Low HDLC	94	40.51	33	22.92	127	33.77
Hypertension	72	16.44	21	10.00	93	14.58
Obesity	64	14.68	33	15.71	97	15.02
Tobacco use	234	53.18	0	0.00	234	53.18
Sedentary lifestyle	116	26.36	108	51.43	224	34.46

HDLC, high density lipoprotein cholesterol.

Table 4. Age standardized prevalence of obesity, hypertension and dislipidemia among subjects from Tirupati, India

Risk Factor	Crude (% prevalence)	Standardized age (% prevalence)	95% CI
Hypercholesterolemia	19.60	18.56	13.88–23.24
Hypertriglyceridemia	47.51	45.98	36.47–55.49
Low HDLC	33.77	31.01	24.25–37.77
Hypertension	14.57	13.13	9.11–17.15
Obesity	15.02	14.37	11.06–17.68

HDLC, high density lipoprotein cholesterol.

both men and women were positively associated with SES ($P < 0.05$). In women, low HDLC was more common among the lower SES groups, whereas in men, the prevalence of obesity and hypertension increased with higher social class (Table 5). SES levels were positively associated with mean levels of cholesterol and triglycerides (Table 6). There was a negative relationship between HDLC and SES levels among women, and among men, systolic BP and BMI were positively associated with SES levels.

Discussion

The findings from the study showed that coronary risk factors such as hypercholesterolemia, hypertriglyceridemia and sedentary life style were more prevalent among higher SES groups. Low HDLC, on the other hand, was more common in lower SES groups. Men in the higher socioeconomic groups had higher prevalences of hypertension and obesity. A recent report on the prevalence of CHD risk factors among the Indian social classes has shown similar results.[19] However, these findings differ from those seen in developed countries, where coronary risk factors and deaths due to non-communicable diseases have been more common in the lower social classes.[9] These differences may be due to different dietary patterns and living styles.

An elevation in the levels of cholesterol among higher SES groups indicated greater risk of CHD. Previous Indian research suggests that people with a cholesterol level greater than 300 mg% have four times the risk of CHD than people with less than 200 mg%.[20] Recent reports indicate that, Indian populations with a mean cholesterol level of 150 mg% or less have little risk of CHD.[21,22] Indeed, higher levels of HDLC appear to convey protection against CHD.[23]

Table 5. Prevalence of obesity, hypertension and dislipidemia by socioeconomic status among subjects from Tirupati, India

Groups	Pooled	HC		HTG		Low HDLC		Hypertension		Obesity		Smoking		Physical activity	
		Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Group I	147 (23)	28 (35.9)	12 (80.0)	38 (79.2)	6 (40.0)	18 (34.8)	0 (0.0)	28 (27.5)	3 (6.7)	4 (33.3)	3 (6.7)	56 (54.9)	0 (0.0)	40 (39.2)	33 (73.3)
Group II	160 (24)	18 (16.7)	12 (30.8)	50 (71.4)	18 (46.2)	18 (33.3)	3 (7.7)	20 (17.0)	3 (7.1)	20 (17.2)	9 (21.4)	58 (49.2)	0 (0.0)	40 (29.0)	36 (85.7)
Group III	79 (12)	0 (0.0)	3 (25.0)	6 (33.3)	0 (0.0)	12 (46.2)	0 (0.0)	6 (11.5)	6 (22.2)	0 (0.0)	9 (33.3)	26 (50.0)	0 (0.0)	20 (29.4)	18 (66.7)
Group IV	153 (25)	4 (5.6)	12 (26.7)	24 (52.2)	6 (25.0)	28 (48.3)	9 (21.4)	8 (8.5)	6 (10.5)	6 (6.4)	6 (10.5)	62 (64.6)	0 (0.0)	12 (17.7)	12 (21.1)
Group V	111 (17)	4 (6.3)	6 (16.7)	14 (29.2)	0 (0.0)	20 (41.7)	21 (58.3)	10 (13.9)	3 (7.7)	4 (5.6)	6 (15.4)	32 (44.4)	0 (0.0)	4 (6.3)	9 (23.1)
Total	650 (100)	54 (15.1)	45 (30.6)	132 (57.4)	30 (27.0)	94 (40.5)	33 (22.9)	72 (16.4)	21 (10.0)	64 (14.7)	33 (15.7)	234 (53.2)	0 (0.0)	116 (26.4)	108 (51.4)
Mantel–Haenzal χ^2		38.78	12.32	29.82	14.26	1.86	29.68	6.79	0.19	34.42	0.11	0.01	—	11.86	16.59
P-value		< 0.05	< 0.05	< 0.05	< 0.05	NS	< 0.05	< 0.05	NS	< 0.05	NS	NS	—	< 0.05	< 0.05

HC, hypercholesterolemia; HDLC, high density lipoprotein cholesterol; HTG, hypertriglyceridemia; NS, not significant.

Although, the HDLC levels were higher among higher social classes, it is possible that their elevated total cholesterol may neutralize the beneficial effect of higher HDLC levels.[24] Further supporting this view was the finding of higher levels of triglycerides (> 120 mg%) among the higher social classes. To the best of our knowledge, this link between serum triglyceride levels and other CHD risk factors has only been observed once among Indian subjects.[25] Thus, the higher concentrations of SC and TG among the higher SES groups may subject them to greater CHD risk.

A higher percentage of men and women in the higher social classes had more sedentary habits, which may increase their risk of CHD. In his analysis of the global burden of disease, Christopher[26] has shown that non-communicable diseases caused 34% of deaths among the poor and up to 85% of deaths among the richest sections of the population. The transition from poverty to affluence is likely to lead to a decline in communicable diseases compared to non-communicable diseases. In many countries, this transition tends to favour the adoption of atherogenic diets and physical inactivity, which are considered to be major CHD risk factors.[21]

In the developed world, increased awareness and education about diet and lifestyle risk factors may have been partly responsible for the decline in CHD prevalence among the higher social classes.[26] However, the situation in developing countries, especially in India, is different. Rapid industrialisation and urbanisation have brought about enormous changes in dietary patterns and lifestyles.[27] This is most obvious among higher SES groups, which tend to experience a greater prevalence of CHD risk factors.[19]

National nutrition surveys in India indicate that dietary fat intake is much higher in high and middle income urban populations compared to low income groups.[28] Seventeen percent of rural social class V subjects do not consume any edible fat, whereas about 5% of higher social class subjects consume 40% of available dietary fat. These diet and life style changes have been associated with a modest increase in overweight and hypertension.[28] In the present study, hypertension and obesity were found to be positively associated with SES in men only. It has been observed that increases in the prevalence of obesity and hypertension are not invariable accompaniments of lifestyle change though they are often present.[29,30] For example, studies of the Indian immigrant population in the UK suggest that hypertension does not make a significant contribution to CHD risk, although a significant contribution has been observed in the Sri Lankan community.[31]

While the age standardized prevalence of dislipidemia, hypertension and obesity in the study sample were higher than those observed in the Framingham study,[32] they were not as high as those reported in studies of migrant South Asian and other Indian populations.[31,33] The prevalence rates observed in the present study were: hypercholesterolemia, 19%; hypertriglyceridemia, 46%; low HDLC, 31%; hypertension, 13%; obesity, 14%. Among North Indian urban populations, there is a greater prevalence of higher profile

Table 6. Metabolic and anthropometric measurements (Mean ± SD) by socioeconomic status in subjects from Tirupati, India

Parameter	Sex	Group I	Group II	Group III	Group IV	Group V	*F*-value
Serum cholesterol (mg%)	M	176.85 ± 43.91	160.81 ± 39.49	143.50 ± 31.57	147.67 ± 40.40	155.66 ± 30.69	3.68*
	F	224.00 ± 38.33	184.85 ± 30.39	189.00 ± 23.61	173.47 ± 45.37	160.67 ± 36.61	2.73*
HDLC (mg%)	M	42.96 ± 14.10	42.44 ± 11.99	40.69 ± 15.32	37.28 ± 10.81	37.92 ± 11.99	1.09
	F	56.40 ± 11.76	55.46 ± 13.97	60.25 ± 4.11	48.79 ± 16.46	33.00 ± 13.77	5.49*
LDLC (mg%)	M	105.33 ± 23.71	89.12 ± 29.75	71.80 ± 22.14	83.92 ± 42.82	93.13 ± 27.93	1.29
	F	142.36 ± 48.38	105.77 ± 35.65	111.00 ± 28.53	116.20 ± 37.75	110.86 ± 51.59	0.74
Triglycerides (mg%)	M	146.71 ± 56.61	143.37 ± 50.93	117.78 ± 56.85	128.52 ± 44.36	106.58 ± 41.48	2.77*
	F	126.20 ± 26.49	118.08 ± 33.77	96.67 ± 5.03	90.87 ± 42.37	79.38 ± 24.33	2.74*
Systolic BP (mmHg)	M	129.31 ± 12.41	125.76 ± 11.74	122.12 ± 10.88	122.87 ± 11.02	123.61 ± 13.13	2.61*
	F	112.67 ± 14.98	111.43 ± 13.21	120.56 ± 18.62	121.05 ± 22.70	117.31 ± 16.53	0.89
Diastolic BP (mmHg)	M	83.33 ± 7.05	82.03 ± 8.20	80.58 ± 7.79	79.68 ± 7.96	79.86 ± 8.06	1.86
	F	76.03 ± 8.75	76.00 ± 6.46	79.84 ± 9.16	78.05 ± 9.87	77.69 ± 8.56	0.30
Pulse rate (beats/min)	M	80.17 ± 5.16	79.91 ± 5.33	78.10 ± 4.73	77.71 ± 7.02	79.44 ± 6.61	1.44
	F	79.00 ± 3.95	77.40 ± 2.68	80.22 ± 5.95	79.00 ± 8.04	79.46 ± 9.68	0.22
Body mass index (kg/m^2)	M	23.15 ± 3.62	21.98 ± 2.77	21.01 ± 2.01	20.58 ± 3.32	20.22 ± 2.52	7.08*
	F	21.36 ± 4.43	21.29 ± 3.32	22.59 ± 3.98	21.38 ± 2.47	22.49 ± 2.75	0.62
Skinfold ratio	M	1.36 ± 0.48	1.38 ± 0.39	1.38 ± 0.41	1.34 ± 0.40	1.49 ± 0.38	0.82
	F	1.28 ± 0.31	1.33 ± 0.40	1.45 ± 0.57	1.66 ± 0.57	1.54 ± 0.62	1.58
Age (years)	M	39.63 ± 9.88	35.80 ± 6.40	34.57 ± 9.46	37.96 ± 12.16	37.53 ± 15.53	1.35
	F	27.53 ± 9.78	24.43 ± 7.27	32.44 ± 12.99	41.94 ± 15.28	43.54 ± 15.46	6.68*

Statistical significance (ANOVA): *$P < 0.05$. BP, blood pressure; HDLC, high density lipoprotein cholesterol; LDLC, low density lipoprotein cholesterol.

CHD risk factors, for example 58% were hypertensive, 33% were obese and 71% had hypercholesterolemia.[34] This high rate has been attributed to changes in diet and food habits, as well as increases in leisure time physical inactivity.[34] In contrast, recent findings from an affluent tribal population in South India showed that this population had lower CHD risk factor prevalence rates than urban and other rural communities in India.[35] The authors suggested that balanced nutritional status and optimum physical activity kept the tribal community's prevalence rates low.[35]

In conclusion, these findings add to the body of evidence that suggests that higher social classes in developing countries may have greater CHD risks than lower social classes. Rapid growth in industrialisation and urbanisation may have led to changes in dietary patterns and a reduction in physical activity in this study population, as has been the case in other Indian populations.[2,3,11] It is estimated that, more than 40% of the population in developing countries like India are now living in urban areas. CHD mortality rates are likely to increase among the higher social groups in urban areas. This epidemic may be halted through the promotion of healthier lifestyles[36] and the support of environmental and policy changes. Perhaps restoration of some family aspects such as joint families, good education, yoga practice, increases in work and leisure time physical activity and traditional food consumption patterns would help to mitigate this burden.

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