The Role of Socio-economic Indicators in the Causation of Coronary Artery Disease

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Abstract- South Asian countries have a high prevalence of coronary heart disease (CAD) in line with their economic development. In these countries, we find nearly one quarter of the total world population in the process of nutritional transition, from poverty to affluence due to rapid economic development. India; in particular, with a population of over one billion has a high burden of CAD. To evaluate the role of socio-economic and demographic variables on the coronary artery disease. A hospital based case-control study was conducted to investigate the role of social related risk factors on coronary artery disease (CAD) in an urban area of East Delhi from April 2002 to December 2004. To obtain more validate comparisons, a control group also was selected from community of East Delhi. The tools of enquiry were a pre-tested and pre-coded questionnaire, physical examination and laboratory testes. A confidence level of 95% and study power of 80% were considered for the interpretation of possible significant findings. Sexwise stratified analysis was separately done for male and female subjects. Comparison of male cases with their counterparts in both control groups indicated that the majority of them had significantly a college education, higher monthly income, semi or full professional occupations and were living in families with size of more than 9. The similar results was found for female cases as that majority of them as compare to females in both control groups were literate, employed and belonging to families with income levels of more than RS.8000. In addition, belonging to religion other than Hindus was another significant variable that was accounted for as risk for getting CAD. Our findings indicate that both male and female cases belonging to high socio-economic classes had higher chance for getting CAD as compare to their counterparte.

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Key words: SES, CAD, Risk factors, Case-Control study, urban areas, Delhi, India

Introduction

Social and economic inequalities have been shown to be associated with health problems in general and non-communicable diseases such as diabetes, hypertension, dyslipidemia and coronary artery disease (CAD) in particular (1,4,20,21). Since last 40 years, studies in developed countries have shown a consistent inverse relationship between cardiovascular mortality, cardiovascular disease; primarily coronary artery disease and its classic risk factors with many of the indicators of socioeconomic status which may act as a risk factor independent of the other classic coronary artery risk factors (2). However, studies from developing countries have shown no such correlation so that the prevalence rates are more common among middle and above socioeconomic groups as compared to low socioeconomic groups (15-20). Therefore, there is seemingly a paradox in the influence of socio-economic factors noted between developed and developing countries. This paradox is due to different countries where are in different stages of epidemiological and economic transition.[3] South Asian countries have a high prevalence of coronary heart disease in line with their economic development. In these countries, we find nearly one quarter of the total world population in the process of nutritional transition, from

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poverty to affluence due to rapid economic development (9). India; in particular, with a population of over one billion has a high burden of CAD (12). Since there are not enough documents in relation to effect of SES and coronary artery disease in the urban areas of India, the present study was an attempt to explore the role of SES in causation of CAD in an urban area of East Delhi.

Patients and Methods

The study was carried out on the urban population of East Delhi from April 2002 to December 2003 through a design strategy of hospital-based case- control study. 250 cases with acute myocardial infarction were selected from CCU and cardiology wards of Guru Teg Bahadur (GTB) Hospital. Cases were defined as male or female subjects with age range 30 to 75 years, survivors of a first MI as per ICD10 code 410 and residing in the urban area of East Delhi admitted to CCU or Cardiology wards of GTB Hospital in the time period of aforesaid. They had to fulfill the criteria for definite acute myocardial infarction as per the MONICA project – 1) two or more ECG showing specific changes, 2) ECG showing probable changes plus abnormal cardiac injury enzymes, or 3)
Typical symptoms such as retrosternal pain plus abnormal enzymes. All diagnostic criteria for the cases were confirmed by the only expert Cardiologist working in the cardiology ward of hospital.

The same number of Controls also were drawn from inpatient and outpatient wards of certain clinical departments of the hospital such as surgery, eye, and ENT wards. Using appropriate formula and considering a confidence level of 95% and study power of 80%, a total of 500 Study subjects including 250 Cases and 250 Hospital controls were studied**.** Cases and hospital controls were selected by consecutive sampling method. To ensure comparability between cases and controls also to check whether hospital controls are different from the community, we selected a number of 250 community controls from different colonies of East Delhi according to an initial analysis of cases as per their place of residence.

The East District of the state of Delhi has a population of around 5 million, distributed in eight assembly constituencies. Community controls were selected by systematic random sampling. The tool of enquiry was a pretested-precoded questionnaire administered to both the case and control groups. Age was matched for both the case and control groups (with an interval of ±2 years). Sexwise stratified analysis was done for male and female subjects separately. Association of Socio-economic including education, occupation, income and demographic variables such as religion, type of family and family size with CAD was studied using both Univariate and Multivariate statistical techniques.

Results

In this study, 82% of cases, 75% of Hospital controls and 81% of Community controls were male and no significant association was found with respect to sex and coronary artery disease ($P > .05$). The demographic & socio-economic characteristics of males in case and control groups are shown in table 1. The higher percentage of males in case and both hospital and community control groups were living in families with size of 1-4 (43.5, 51.5 and 54.5 respectively). However, proportion of male cases with family size of more than 9 was significantly higher than those in both control groups so that the odds ratio (OR) for CAD for male cases versus hospital controls was 4.80 (95% CI, 1.88-12.47) and 2.20 (95% CI, 1.2-5.2) for male cases versus males in community group. No significant association was found between religion as well family type and coronary artery disease in none of the comparisons ($P > .05$).

Comparison of males in case group with their counterparts in both control groups indicated that the majority of them had significantly a college education, higher monthly income and semi or full professional occupations. Based on univariate analysis, the odds of getting CAD amongst male cases with education levels of high and intermediate school as well graduate and post-graduate was more than twice and four times higher than in males in hospital controls respectively (OR 2.38,95% CI 1.31-4.34 and OR 4.29, 95% CI 2.06-9.01). Similar significant odds ratios were also found when male cases compared with males in community group. Being in semi and full professional jobs was significantly more common among male cases than in males of hospital control (87, 42.5% vs 43, 23%: OR 2.1, 95% CI 1.23-3.59; $P<0.00$). Comparison of male cases with male controls in community groups also showed the similar significant results (87, 42.5% vs 41, 20.5%: OR 2.58, 95% CI 1.53-4.37; $P<0.00$). Classification of income levels to three categories showed that male cases had significantly higher monthly incomes than males of both control groups as the chance of getting CAD in cases with monthly income levels of equal or more than RS. 8000 was approximately three times more than in hospital controls (74, 36% vs 43, 23%: OR 2.78, 95% CI 1.63-4.76;

Table 1. Demographic & Socio-economic data in male cases & controls

Variable	Cases vs. Hospital Controls			Cases vs. Community Controls		
	Case	*Controls*	x^2, p	*Case*	*Controls*	x^2, p
Religion						
Hindus	161 (78.5%)	155 (82.5)	**72, .40**	161 (78.5%)	156(77)	**.03, .85**
Non-Hindus	44 (21.5)	33 (17.5)		44 (21.5)	46 (23)	
Total	205	188		205	202	
Family type						
-Nuclear	111 (54)	112 (59.5)	**.97, .32**	111 (54)	99(49)	**.88, .34**
-Joint	94 (46)	76 (40.5)		94 (46)	103(51)	
Total		188		205	202	
Family size						
1-3	15 (7.5)	24 (13)	**17.5, <. 001**	15 (7.5)	22 (11.5)	**9.1, .025**
4-6	89 (43.5)	97 (51.5)		89 (43.5)	110 (54.5)	
7-9	53 (25.5)	51 (27)		53 (25.5)	38 (18.5)	
>9	48 (23.5)	16 (8.5)		48 (23.5)	32 (15.5)	
Total	205	188		205	202	
Education						
Illiterate	40(19.5)	62(33)	**24, <. 001**	40(19.5)	49(24.5)	**9.4, <. 024**
Primary & middle	55 (27)	68 (36)		55 (27)	78 (38.5)	
High & intermediate	63 (30.5)	41 (22)		63 (30.5)	47 (23.5)	
Graduate- post G.	47 (23)	17 (9)		47 (23)	28 (13.5)	
Total	205	188		205	202	
Occupation						
Unskilled worker	65(31.5)	81(43)	**22, <. 001**	65(31.5)	79 (39)	**24, <. 001**
Skilled worker	53(26)	64 (34)		53(26)	82 (40.5)	
Clerk, Semi & full professional	87 (42.5)	43 (23)		87 (42.5)	41 (20.5)	
Total	205	188		205	202	
Total family income						
Rs. <4000	55 (27)	89 (47.5)	**18.5, <. 001**	55 (27)	78 (38.5)	**6.5, . 042**
Rs. 4000-7999	76 (37)	56 (29.5)		76 (37)	62 (30.5)	
Rs. ≥8000	74 (36)	43 (23)		74 (36)	62 (31)	
Total	205	188		205	202	

P<0.001) and more than one and half times higher than in males belong to community group (74, 36% vs 62, 31%: OR 1.69, 95% CI 1.02-2.83; *P*<0.05).

Analyses of demographic and socio-economic variables were separately done for female cases and their counterparts in control groups (Table 2). In contrast to significant findings obtained from comparisons of males, no significant difference was shown between family sizes of female cases and females in control groups. However, religion was only demographic variable that was found to be statistically significant when female cases were compared with females in hospital and community controls as the chance for affliction to CAD among female cases with non-Hindus religion was more than three and more than four times higher than that in females in hospital and community controls respectively [13 (29%) vs 7 (17.5%), OR: 3.19, 95% CI 1.05-9.99, *P*=.04] and [13(29%) vs 4(8.5%), OR: 4.47(1.20-18.08), *P*=.02]. Similar to results seen in male group, the higher proportion of female cases compared to females in both control groups had higher levels of education, occupation and monthly total family income. 55.5% of female cases compared with only 32% females in hospital control group were literate as that the odds of getting CAD amongst them was over two and half times more than females in control group (OR: 2.63 95% CI 1.10-6.29, *P*=.027). Compared with females in community controls, the respected odds for female cases was approximately five times (OR: 4.75, 95% CI 1.75-13.17, *P*=.01). Majority of females in case group compared

with female controls in hospital and community groups were employed in outdoor jobs (33.5% versus 8% and 14.5% respectively).The chance for getting coronary artery disease in them was over three and six folds higher than in females in control groups respectively. Comparison of female cases with their counterparts in both control groups showed that higher percentage of them were belonging to families with total monthly family income of ≥ RS.8000 so the odds ratios for CAD for female cases versus females in hospital control group was 4.40 (95% CI 1.31-15.30) and for them versus female in community control group was 5.60(95% CI 1.49-22.22).

Step-wise regression analysis

Stepwise logistic regression analysis was carried out for both continuous and categorical variables having p-value less than .20 on the univariate analysis (table3). The most predictive independent variable in comparison of male cases with their counterparts in hospital control group was education levels of graduate & post graduate (P<.05). Similar finding also was obtained on the model when male cases were paralleled with males in community groups (P<.05). In addition, having occupational levels of semi &full professional was another independent variable that could account for as significant predictor for CAD when male cases were compared with males in community group. In respect with prediction of CAD risk factors in female cases, religion other than Hindus was only significant predictor on the model while female cases were compared with their counterparts in hospital group(p<.05). To be literate and belonging to nuclear families were those predictor factors that were found to be statistically significant when female CAD patients compared with females in community groups (P<.05).

Table 2. Demographic & Socio-economic data in female cases & controls

Variable	Cases vs. Hospital Controls			Cases vs. Community Controls		
	Case	*Controls*	x^2, p	*Case*	*Controls*	x^2, p
Religion						
Hindus	32 (71%)	55 (89)	**4.2, .04**	32 (71%)	44 (91.5)	**5.2, .02**
Non-Hindus	13 (29)	7 (17.5)		13 (29)	4 (8.5)	
Total	45	62		45	48	
Family type						
-Nuclear	21(46.5)	29 (46.5)	**.03, .85**	21(46.5)	15 (31)	**4.6, .030**
-Joint	24 (53.5)	33 (53.5)		24 (53.5)	33 (69)	
Total	45	62		45	48	
Family size						
1-3	6 (13.5)	12 (19.5)	**1.5, .67**	6 (13.5)	8 (17)	**.35, . 94**
4-6	24 (53.5)	35 (56.5)		24 (53.5)	25 (52)	
7-9	10 (22)	9 (14.5)		10 (22)	9 (18.5)	
>9	5 (11)	6 (9.5)		5 (11)	6 (12.5)	
Total	45	62		45	48	
Education						
Illiterate	20(44.5)	42(68)	**4.9, 027**	20(44.5)	38 (79)	**10.5, .01**
Literate	25 (55.5)	20 (32)		25 (55.5)	11 (21)	
Total	45	62		45	48	
Occupation						
Housewife	29(64.5)	57(92)	**7.5, <. 01**	29(64.5)	41 (85.5)	**4.4, .035**
Employment	16(35.5)	5 (8)		16(35.5)	7 (14.5)	
Total	45	62		45	48	
Total family income	15 (33.5)	33 (53.5)	**7.5, .023**	15 (33.5)	30 (62.5)	**9.5, . 008**
Rs. <4000	16 (35.5)	22 (35.5)		16 (35.5)	13 (27)	
Rs. 4000-7999	14 (31)	7 (11)		14 (31)	5 (10.5)	
Rs. ≥8000	45	62		45	48	
Total						

Table 3. Effect of multiple risk factors, modeled with logistic regression: A sexwise Prediction of cases versus control groups

Variable	Cases vs. Hospital controls			Cases vs. Community controls		
	Coefficient	SE	Adjusted OR (95% CI)	Coefficient	SE	Adjusted OR (95% CI)
Education						
Graduate & post graduate(M)	β_1=1.107	0.461	3.02(1.22-7.48)	β_1=0.971	0.456	2.64 (1.07-6.46)
Literate (F)	β_1=1.95	0.625	7.32 (1.66-32.19)			
Occupation						
Semi& full professional (M)		---	---	β_1=0,822	0.337	2.27(1.17-4.40)
Religion						
(Other than Hindus)(F)	β_1=1.741	0.715	5.70 (1.40-23.22)			
Family type						
Nuclear family (F)		---	---	β_1= 1.150	0.370	3.52 (1.0-12.46)

Discussion

The association between CAD and social-related factors depends on the state of the economic development of a country (15). In most of the developing countries, in contrast to developed regions, studies have shown that CAD prevalence rates are more common among middle and above socioeconomic groups as compared to the lowest socioeconomic groups. This can be explained by the fact that these countries are passing through an epidemiological transition where concomitant with socio-economic development and control of communicable diseases, an increase in life expectancy, urbanization rates and adverse changes in lifestyles like change in dietary habits coupled with decreased physical activity have resulted in an outbreak of non-communicable diseases especially coronary artery disease (5,6).

In India, there are very few studies, which have examined the role of socio-economic factors in relation to CAD. However, reviewing the previous studies from rural and urban areas that examined this question, suggested that CAD was more common among wealthier groups (7,8,14,22). Our study, which is probably the first prospective case-control study aimed to identifying the relation between social-related factors and CAD in urban area of East Delhi, shows that individuals belonging to middle and high social classes as compared to individuals in lower social class had higher chance of coronary artery disease. Our results is in concordance with findings of a study conducted by Chadha et al (Delhi, 1990) where the above hypothesis was supported (7). Similar results also were seen in another two separate studies carried out by Singh et al on the urban population of North India (Moradabad, 1996 and 1997) where individuals of both sexes belonging to higher and middle social classes had more prevalence of CAD and CAD risk factors as compared to lower social classes (8). Our data is unlikely to be biased since there was no difference in respect to hospital fees for patients admitted to surgery or outpatient wards and emergency care units such as Coronary Care Unit.

In this study, three main socio-economic indicators namely; education, occupation and income, as well three demographic factors consisting of religion, family type and family size were separately compared between cases and two control groups. The results of our study showed that all socio-economic indicators and majority of demographic factors were found to be significantly associated with CAD in both sexes. However, high levels of education, occupation and belonging to non-Hindus religion and nuclear families were those independent factors which could account for as CAD risk factors on the multivariate model. Patients with multiple risk factors have a substantially increased risk of CAD.

Education played an important role in our study where out of four comparisons done between male and female cases with their counterparts in control groups, in three of those it was found that individuals with graduate & post-graduate education had significantly higher chance of getting CAD as compared with low educated persons. A similar result was observed by Chadha and Singh et al, where the chance of getting CAD amongst individuals with graduate & post-graduate education was found to be more than three times higher than that in individuals belonging to illiterate class [OR= 3.2, (CI=1.22-7.48), *P*<. 01]. Our data is unlikely to be biased since there was no difference in respect to hospital fees for patients admitted to surgery or outpatient wards and emergency care units such as Coronary Care Unit. This however, have to be viewed in the context that higher levels of education is also related to high income levels, high categorization of occupation and different

pattern of lifestyle. Our study results showed a significant association between occupation and CAD where individuals with semi & full professional jobs had higher odds of affliction to CAD compared with persons with manual jobs. Moreover, adjusting with other variables, occupation was accounted for as an independent predictor for CAD on the model when males cases were compared with males in community groups [OR= 2.27 (CI=1.17-4.40) p= .015]. Income also had a significant role in our study as the odds of getting CAD amongst male and female cases with high levels of total monthly family income was significantly more than that in individuals with low income levels. This could be explained by the fact that probably as the education and occupation levels increased there was higher levels of income resulting in higher chance of CAD.

In this study, only female cases with religion other than Hindus (consisting of Muslims, Sikhs, Christians, etc.) and belonging to nuclear families had higher chance of getting CAD as compared with individuals in Hindus religion and living in joint families. No such a relationship was found for male cases. Searching the literatures, no documented paper was found in India to compare the study results. However, these findings may be explained by the fact that there are lifestyle differences between Hindus and non- Hindus where individuals in Hindu religion due to vegetarian type of diet resulting in less fat intake and having more leisure-time physical activity, has a relatively less tendency for getting CAD compared to non-Hindus. also there may be a better psychosocial and family support in the joint families than in nuclear families where a long period of support can lead to prevention of non-communicable diseases such as stress disorders, CAD and cancer especially in women who are more vulnerable than men.

Since the cases in our study are confirmed cases of AMI not known to have had previous coronary artery disease, the research avoids the problem of misdiagnosis associated with single use of ECG diagnostic criteria as has been seen in prevalence studies. In addition, the necessary attentions were considered for the selection of hospital controls and also for removing the possible differential misclassification, a more control group drawn from urban community of East Delhi was added to the study. Considering the above items, and more similarity of cases with community controls than hospital controls as well that education and occupation are considered as two main socio-economic indexes, it can be concluded that in our study individuals with high and middle social classes had higher CAD prevalence than in lower social class.

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