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A case control study of risk factors of coronary heart disease among patients admitted at tertiary hospital in western India

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RESEARCH

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ABSTRACT

Background

Coronary heart disease (CHD) is a major cause of death in the world. In this study, various risk factors of CHD were explored.

Aims

To find out association of CHD with its risk factors in Western India.

Methods

A 100 cases of first episode of Acute Coronary Syndrome (ACS) patients and 200 age and sex matched controls from medical wards of a government run tertiary care hospital were interviewed through modified WHO STEPS questionnaire along with physical examination and anthropometric measurements. Data was cleaned and analysed through SPSS.

Results

On bivariate analysis current smoking status [OR=2.906 (1.69–4.98)], BMI [OR=2.6492 (1.49–4.72)], waist circumference [OR=1.7051 (1.01–2.88)] and positive family history [OR=2.0457 (1.07–3.91)] were found to be significantly associated with ACS cases. On multivariate analysis, BMI [OR=2.612 (1.376–4.959)] and current smoking status [OR=3.005 (1.791–5.042)] were found to be significantly associated with ACS cases.

Conclusion

Out of conventional risk factors, BMI and current smoking status were the only risk factors which had positive association with CHD in this study.

Key Words

Coronary heart disease, WHO STEPS, risk factors, case control study

What this study adds:

1. What is known about this subject?

Increasing burden of coronary heart disease among Indians has been reflected by its earlier onset and higher vulnerability to risk factors.

2. What new information is offered in this study?

Only smoking and Body Mass Index emerged as significant risk factors of coronary heart disease.

3. What are the implications for research, policy, or practice?

It would help to develop guidelines for peripheral health worker to identify risk factors of coronary heart disease for primary prevention.

Background

Over a period of time, the risks tend to shift from infectious disease to chronic disease primarily due to past successes combating infectious diseases; populations worldwide are ageing, and risk factors of chronic diseases are increasing and accumulating among adults.[1] NCDs are responsible for almost two third of all deaths in the world, while cardio vascular diseases (CVDs) are responsible of 48 per cent of all NCD deaths. Thus, almost one third of all deaths in the world are attributed to CVDs. Coronary Heart disease (CHD) is the leading CVD and it is responsible for close to half (42 per cent) the CVD mortality. So, around 14 per cent deaths across the world are attributed to CHD.[2,3]

CHD is considered an epidemic in India.[4] It is predicted that India will be host to more than half the cases of CHD in the world within the next 15 years.[5] In India about 50 per cent of the CHD related deaths occur in people younger than 70 years compared with 22 per cent in the West.[6,7]

CHD is not caused by one single factor. Its pathogenesis involves many causes and mechanisms that are interwoven. Some of the risk factors also enhance the effect of the others (i.e. obesity raises blood pressure etc.).[8] Behavioural risk factors (tobacco use, unhealthy diet, physical inactivity, harmful use of alcohol etc.) are estimated to be responsible for about 80 per cent of coronary heart disease.[2,3,9,10] The INTERHEART case-control study covering 52 nations including India had reported that nine established risk factors (high apolipoprotein B/A ratio, smoking, hypertension, diabetes, obesity, psychosocial stress, low fruit and vegetables intake, low alcohol intake and sedentary lifestyle) were responsible for mostly all (>90 per cent) episodes of acute myocardial infarction.[11] Previous case-control studies from India have reported importance of smoking, hypertension, diabetes, and abnormal lipids.[4]

Risk factors of CHD have already been known to us, but extents to which these risk factors are distributed in the patient of CHDs are yet to be fully explored in India.[12] So to answer some of the questions asked in current context, we conducted this case control study with the objective to explore the extent to which these established risk factors are spread in the patients of first episode of Acute Coronary Syndrome (ACS) who had no prior history of CHD requiring them to seek treatment at a health care institution.

Method

Setting

This study was carried out in the medical wards of a government run tertiary care hospital in Vadodara district, Gujarat, India from November 2011 to November 2012.

Definitions

A Case[13] was defined as a patient presented with acute chest pain, specific ECG changes and diagnosed as having ACS (first episodes only) by physician on duty in ICCU. Patients with any past history of CHD were excluded. Biomarkers like CK-MB (Creatinine Kinase – Muscle Brain) and Troponin I had been done to aid diagnosis, whenever possible. It includes ST segment elevated Myocardial Infarction (STEMI), Non ST segment elevated Myocardial Infarction (NSTEMI) and Unstable Angina (UA). Diagnostic algorithm is shown in Figure 1.

A Control was defined as any patient who was admitted in medical wards of the institute and who had been diagnosed by physician in charge as having any medical condition other than CHD or its complications.

Current smoker was defined as individual who smoked tobacco (cigarettes or bidis) in at least last 1 year.[14] 'Current user of smokeless tobacco' and 'Current user of alcohol' was defined as Individual who used it in at least last one year. Blood pressure and plasma glucose may get altered during the time of the episode of ACS. Hence, self-reported history of hypertension, diabetes, dyslipidemia was asked to each participant. All patients were asked about frequency of vegetables and fruit intake and type of oil they are using.

Waist hip ratio and BMI were calculated at the time of analysis by using height and weight (for BMI). Participants with BMI >25 were considered obese.[15] For waist circumference, cut off limit was taken as 90cm and 80cm for male and female respectively. For waist to hip ratio (WHR), cut off limit of 0.85 and 1.00 was taken for female and male respectively.[11,15,16]

A participant was considered to have positive family history if any first degree relative of a participant was reported to be a known case of CHD or diabetes or hypertension or Cerebro Vascular Disease (CeVD).

Recruitment

Those patients who refused to participate in this study; very ill, debilitated, unconscious, comatose patients; with diseases that affect sensorium or memory (i.e., Alzheimer's disease, dementia, metabolic encephalopathy etc.); with past history of CHD or CV Stroke; recent case of abdominal distension i.e. Liver Disease (false high waist circumference, waist/hip ratio might have been obtained); Patients who were unable to stand were excluded.

Controls were matched with cases by their gender and age (five-year interval). Since cases and controls were from similar socio economic background, they were not matched for the same.

Sample size calculation

Pilot study included risk factors like Current smoking, Current use of smokeless tobacco, Obesity (by using cut-offs for BMI, WHR and WC) and family history of selected NCDs. It showed that the least difference between cases and controls existed for Obesity by Waist Circumference (WC) – which was 25 per cent and 10 per cent among cases and controls respectively. Thus, Odds ratio=3; Control: case=2:1; Type 1 error=5 per cent; Power=90 per cent; Non response rate=10 per cent; Calculated sample size=99. Hence 100 cases and 200 controls were decided to be enrolled in the study. Sample size was calculated using Epi Info software version 7.

Necessary ethical clearances and administrative permissions were obtained. Questionnaire from WHO-STEPS approach for cardiovascular disease surveillance[17] was modified after it was pre tested in a pilot study. All participants were interviewed in vernacular language after getting written informed consent. It included oral questionnaire for demographic information (age, gender, religion, education, per head family income etc.); various risk factors of coronary heart disease (smoking, smokeless tobacco, alcohol, diet, diabetes, hypertension, dyslipidaemia, family history, consumption of fruit and vegetable) and physical examination (height, weight, waist circumference (WC), hip circumference).[13] All participants were interviewed by same interviewer to minimise interviewer bias. Cases and controls were interviewed for almost same length of time with similar emphasis put on each question.

Data entry and analysis

The data was entered in the Microsoft Excel 2010 worksheet and analysed in SPSS version 20 and Epi Info version 3.5.3. Appropriate statistical tests were applied. P value of less than or equal to 0.05 was considered statistically significant.

Results

In this study, there were 100 cases and 200 controls. As shown in Table 1, 78 per cent and 22 per cent of study participants were men and women respectively. Mean age and mean per capita income of cases and controls according to their sex are mentioned in Table 1. Difference between both groups for both the variables was not statistically significant. There were 63 cases (63 per cent) whose age was less than 60 years.

Table 2 shows distribution of various risk factors among both the groups. Of all risk factors, current smoking [Odds ratio=2.906 (1.69–4.98); (P value=0.0000850)]; BMI (above the cut off for obesity) [OR=2.6492 (1.49–4.72); (p value=0.0007582)]; Waist Circumference (above the cut off for obesity) [OR=1.7051 (1.01–2.88); (p value=0.0446)] and positive family history for selected CVDs [OR=2.0457 (1.07–3.91); (p value=0.028)] were statistically significantly associated with cases at 95 per cent confidence level.

While association of other risk factors with cases was not statistically significant at 95 per cent confidence level. These risk factors included current usage of smokeless tobacco products [OR=0.9953 (0.5582–1.7749); (P value=0.9873)]; current usage of alcohol [OR=0.9947 (0.4250–2.25); (P value=0.9562)]; hypertension [OR=1.2944 (0.68–2.47); (p value=0.432)]; and diabetes [OR=0.8041(0.39–1.65); (p value=0.552)] (Table 2). Self-reported history of dyslipidaemia had been found in very few patients; hence it was excluded from analysis.

Waist to hip ratio (WHR), [OR=1.60 (0.97–2.66) with p value=0.066] was not statistically significantly associated with cases at 95 per cent confidence level. However, WHR was significantly associated at 93% CI (Table 2).

There wasn't any statistical difference between both the groups for their dietary habits. Mean intake of fruits was 3.85 (SD=6.559) and 3.46 (SD=6.200) days a month by cases and controls respectively. Mean intake of vegetables was 6.16 (SD=1.74) and 6.35 (SD=1.48) days a week by cases and controls respectively. Any of the differences was not statistically significant. Majority of cases (n=78) and controls (n=155) had cottonseed oil as preferred oil. For any of the oils used by participants, there wasn't any statistically significant difference between cases and control (Data not shown in tables).

By performing unconditional multivariate analysis, BMI [OR=2.612 (1.376–4.959); (P value=0.003)] and Current Smoking [OR=3.005 (1.791 - 5.042); (P value=<0.001)] were found to be statistically significant at 95 per cent CI (Table 3).

Discussion

Difference of age and per capita income between both groups was not statistically significant; both the groups had similar no of men and women. Thus, these results show proper matching for age, gender and per capita income (Table 1). Proportion of female participants was 22 per cent in this study; this finding was in concordance with the findings of some of the recent retrospective studies in India.[18–20] Mean age (and SD) of cases and controls were 56.48 (10.87) and 55.93 (10.746) years respectively in the study. Almost similar findings were obtained in CREATE registry for ACS;[21] the INTERHEART study, (Indian counter part of participants);[22] a retrospective study by Babu et al.[19]; CUPS (Chennai Urban Population Study).[23]

Smoking is a known risk factor for CHD. In present study, OR for current smoking was found out to be 2.906 (1.69–4.98) and exposure rate among cases was 62 per cent (Table 2). This finding was lent support by Rastogi et al.;[18] the INTERHEART study;[11] Rahman et al.[24] In these studies, exposure rate of current smoking was same or less than that of current study, but all of them agreed that cases had statistically significantly higher exposure. Research on the effects of smokeless tobacco on CHDs is limited, because majority of studies are related with cancers. Rahman et al.[24] in Dhaka and Trivedi et al.[25] in India obtained a significant association between CHD and smokeless tobacco products. This finding of current study differs; probable reasons behind that might be the selection of control group from medical wards in this study. As Table 2 shows, there wasn't any significant association between alcohol intake and ACS cases in this study. Rastogi et al.[18] and Trivedi et al.[25] had found significant association while non-significant association was found in CUPS[23] and Bagchi et al.[26] Hence, various studies had different findings for alcohol and ACS. Moreover, it is difficult to quantify alcohol content in the product owing to different procedures of making it at different places. Alcohol has less social acceptance and there is legal restriction on production and sale in Gujarat State. So, response of the participants might be "false low" in terms of their use, frequency and amount. Thus results obtained here should be interpreted with caution. This study revealed that there was no significant association between dietary habit (measured only for vegetables and fruits) and ACS. Rastogi et al.[18] observed a significant and dose-dependent inverse association between vegetable intake and CHD risk. They noted that non-significant association existed for vegetables, Vanaspati ghee and significant association was found out to be for mustard oil. Similarly, there wasn't significant association between "protective diet" (>2 servings of vegetables and fruits) and ACS in the INERHEART study.[11] Use of oil and ghee was found to be significantly associated with ACS in study conducted by Trivedi et al.[25] Quantification of vegetables, oil and fruits was difficult and it was beyond the scope of the study.

Hypertension is a known risk factor of ACS; it wasn't a significant risk factor in this study (p=0.432). However, review of literature shows that hypertension has been significantly associated with cases of CHD or ACS in various studies conducted by Rastogi et al. ($p \leq 0.0001$),[18] INTERHEART study [OR (99 per cent CI)=2.48 (2.30–2.68)],[11] Trivedi et al.,[27] CUPS($p<0.001$)[23] and Rahman et al. ($p<0.001$).[24] Diabetes has been a known risk factor of ACS, but this study did not find statistically significant association between diabetes and ACS. In CREATE registry, 6226 (30.4 per cent) patients had diabetes among patients of ACS.[21] OASIS 1 and 2 registry (1,028 patients enrolled from India) reported 39.1 per cent of all ACS patients from India were diabetic.[20] While other studies conducted by researchers like Babu et al.,[19] also found similar findings. Rahman et al.[24] found no association between diabetes and ACS (p=0.89), while the INTERHEART study[11] [OR (95 per cent CI) = 3.08 (2.77–3.42)] found the existence of statistical significance. Difference in methodology (selection of controls from medical wards) or definition of cases in different studies (first episode of ACS or first episode of AMI or first timed diagnosis of CHD) might explain results of this study to be different from others. In this study, anthropological measurements like BMI and WC were significantly associated with ACS at 95 per cent confidence level. Interestingly, BMI was found to be significantly associated with ACS.[15] WHR was not associated with ACS at 95 per cent confidence level, but at 93 per cent confidence level. BMI was found to be significant risk factor in various studies like CUPS23, INTERHEART study[11] and Rastogi et al.[18] Waist hip ratio was established as a significant risk factor in studies conducted by Rastogi et al.[18] and in INTERHEART study.[11] CUPS[23] revealed waist circumference as a significant risk factor for ACS. Thus, barring waist circumference, study findings related to anthropology are coherent with other studies. As found in this study, family history has been an important risk factor for ACS. Similar findings were obtained by Rastogi et al.[18] ($p<0.0001$), Trivedi et al.[27] ($p<0.05$), INTERHEART study[11] [1.45 (1.31–1.60) - Adjustments for the nine previously described risk factors]; while it was not associated in study conducted by Rahman et al.[24] (p=0.60). Age and BMI were significant risk factors in CUPS.[23] Panwar[4] concluded that smoking, hypertension; various dyslipidemias were significantly associated but BMI. WC and WHR were not assessed in their study.

In this case control study matching (at design level), standardized protocol for study (at study conduct level) and multivariate analysis (at analysis level) were carried out to minimise the effect of confounding. Only first episode of ACS was involved in the study as subsequent episodes might change the behaviour risk factor profile and anthropometrics. Being a case control study, it allowed rapidity and cost effectiveness along with simultaneous study of many risk factors. Study was conducted at a government run tertiary care institute and findings can be extrapolated to other similar hospitals. As these hospitals provide treatment at no or minimal cost, it can be reasonably implied that majority of the poor and perhaps the middle class people of the community in this part of

India would visit these institutes for ACS. Moreover, ACS has hardly been an iceberg disease due to excruciating chest pain as a symptom; majority of the cases would be reported to such institutes if not died already. This may allow a careful extrapolation of findings to patients of ACS visiting government run hospitals.

This case control study, conducted in a tertiary health care set up, excluded study participants from private health care set up, thus its external validity is limited to such tertiary care institutes. Controls chosen from medical wards might have narrowed or nullified the potential statistically significant difference for many established risk factors of CHD. Physical activity and lipid profile assessment were beyond the scope of this study. Research of similar kind should be replicated in different geographies to understand distribution of various risk factors of the rapidly increasing problems of CVD and CeVD in India. A peripheral health worker may be recommended to identify persons with such risk factors in order to take preventive steps.

Experimental studies validating the effectiveness and not mere the efficacy of appropriate interventions would be the next step to follow to generate robust evidence for designing a policy to be applied to a wider scale.

Conclusion

This study has shown smoking and BMI as significant risk factors for CHD among patients of ACS at hospital.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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ETHICS COMMITTEE APPROVAL

Scientific and Ethical Research Committee (SERC), Medical College & SSG Hospital, Baroda.
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Figure 1: Diagnostic algorithm of Acute Chest Pain with specific ECG changes[13-15]

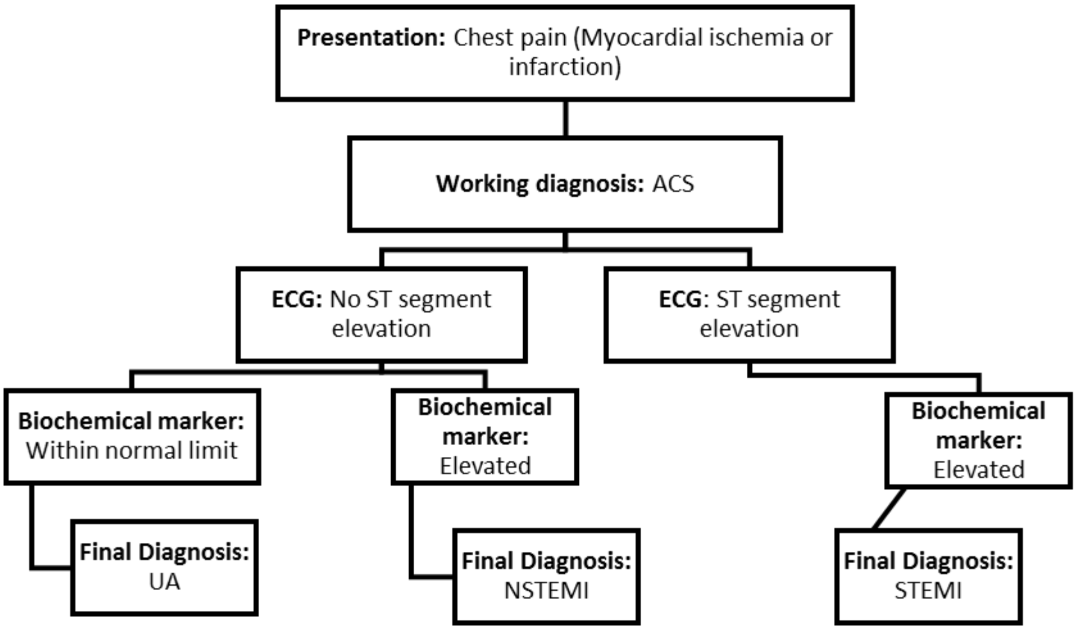

Table 1: Profile of the study participants

		Case	Control	Total	P value
Gender (No and % among group)	Male	78 (78%)	156 (78%)	234 (78%)	-
	Female	22 (22%)	44 (22%)	66 (22%)	
	Total	100 (100%)	200 (100%)	300 (100%)	
Mean (SD) age (years)	Male	56.70 (10.87)	56.07 (10.84)	56.28 (10.83)	0.68
	Female	55.68 (11.09)	55.43 (10.50)	55.52 (10.62)	0.92
	Total	56.48 (10.87)	55.93 (10.746)	56.11 (10.73)	0.678
Mean (SD) Per capita income per month (Rupees)		1345 (931)	1650 (1517)	1548 (1356)	0.066

Table 2: Summary of various risk factors of CHD

Risk factor	Cases (No. and %)	Controls (No. and %)	Odds Ratio and 95% Confidence Limits	P value
Current smokers	**54 (62.07%)**	**58(36.02%)**	**2.91 (1.69 – 4.98)**	**<0.001**
Current users of Smokeless tobacco products	23 (23.96%)	44 (24.04%)	0.995 (0.56 – 1.78)	0.9873
Current users of alcohol	9 (10.59%)	20 (10.81%)	0.99 (0.43 – 2.25)	0.9562
Hypertension	18 (18%)	29 (14.5%)	1.29 (0.68-2.47)	0.432
Diabetes	12 (12%)	29 (14.5%)	0.80(0.39 – 1.65)	0.552
BMI (>25 Kg/m^2) *	**31 (31%)**	**29 (14.5%)**	**2.65 (1.49 – 4.72)**	**<0.001**
High # Waist to hip ratio	39 (39%)	57 (28.5%)	1.60 (0.97 – 2.66)	0.066
High *# Waist circumference	**35 (35%)**	**48 (24%)**	**1.71 (1.01 – 2.88)**	**0.0446**
Family history ##	**21 (21%)**	**23 (11.5%)**	**2.05 (1.07 - 3.91)**	**0.028**

*cut off for BMI was taken as 25 for obesity.

for men > 0.99 and for women > 0.84

*# for men > 89 cm and for women > 79 cm

Family history of at least one of four conditions (Diabetes, Hypertension, CHD, CV Stroke)

Table 3: Unconditional Logistic Regression analysis of various risk factors

Risk factor	Adjusted Odds Ratio (AOR)	95% Confidence Limits of AOR		P-Value
BMI* (≥25 vs <25)	2.612	1.376	4.959	**0.003**
Current smoker (Yes vs No)	3.005	1.791	5.042	**<0.001**
Family history of any one of four ## risk factors (Yes vs No)	1.672	0.837	3.340	0.145
Waist circumference*# (high vs not high)	1.111	0.612	2.014	0.730

* cut off for BMI was taken as 25 for obesity.

*# for men > 89 cm and for women > 79 cm

Family history of at least one of four conditions (Diabetes, Hypertension, CHD, CV Stroke)