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# A CASE-CONTROL STUDY OF CORONARY HEART DISEASE IN URBAN SLUM POPULATION OF MUMBAI

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**Abstract-** The developed countries have utilized research findings on the modifiable risk factors for Coronary Heart Disease (CHD) such as smoking, elevated blood cholesterol, sedentary life style and high blood pressure to produce a major impact on prevention of CHD. Today in our country, the increasing prevalence of CHD in the young and the impact on longevity from control of communicable diseases necessitates concerned effort by scientists, policy makers and planners.

The objectives of present study are to study the various factors associated with Coronary Heart Disease in the age group of 25-64 years and find out independent effect of multiple factors on occurrence of Coronary Heart Disease (CHD). The study was designed to be a case-control study conducted in an urban slum, community with a population of 35,967, served by Urban Health Centre. Total 186 cases (126 males and 60 females) of CHD were found in the community and equal numbers of controls were selected matching age & sex, two non-modifiable factors in 1:1 proportion. Majority of cases were Muslims as the community was predominantly having Muslim population. The average family size was 5.95 among cases while it was 5.44 among controls. The proportion of singles was more in comparison with controls (7, 3.8%) and found statistically significant. Socio-economic Class (based on Per Capita Income) wise there was no significant difference among cases and controls. The risk of suffering from CHD to those who had not done exercise was found 10.7 times more than those who had the habit of it. In the age group of 55 to 64 years 81 males (75.7%) and 31 females (81.6%) were suffering from hypertension in comparison with 15 males and 7 females in controls. The risk was 32 times more for those who were suffering from Hypertension. The mean systolic blood pressure of CHD cases was 161.8 mm of Hg (SD-18.4 & SE-1.35) while mean diastolic blood pressure was 97.6 mm of Hg (SD-10.3 & SE-0.76). Among controls the mean systolic blood pressure was 127.3 mm of Hg (SD-14.8 & SE-1.08) while mean diastolic blood pressure was 81.8 mm of Hg (SD - 8.3 & SE-0.61). Among cases cholesterol levels were high. The 73% of cases were having cholesterol levels above 240 mg/dl while only 13.4% controls were having that high level. It was found that occurrence of CHD depends on number of bidis and /or cigarettes smoked rather than presence or absence of smoking. The present study indicates that among multiple risk factors of Coronary Heart Disease Systolic Blood Pressure, Cholesterol, built, Type of work, family history of CHD, Diastolic Blood Pressure, Family size, Smoking, Diabetes Mellitus and Tobacco chewing are having significant independent effect even in urban slum population having predominantly low socio-economic status. In view of these findings and in order to combat this newly emerging Public Health Problem, a multipronged attack need to be launched at multiple levels, considering Prevention is the best solution.

**Keywords-** Coronary Heart Disease, NCD, Epidemiology, Urban

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## Background

As Omran has proposed, three eras of epidemiologic transition countries experience at different stages of their social and economic development. These are namely, the era of pestilence and famine, the era of receding pandemics and the era of degenerative and manmade diseases. India at present is at transitional phase between stage 2 and stage 3. However as India ascends the socio-economic ladder of development, non- communicable diseases like Coronary Heart Disease (CHD) will emerge *dominant paripassu* with decline of communicable and nutritional disorders.

The developed countries have utilized research findings on the modifiable risk factors for Coronary Heart Disease such as smoking, elevated blood cholesterol, sedentary life style and high blood pressure to produce a major impact on prevention of CHD. Today in our country, the increasing prevalence of CHD in the young and the impact on longevity from control of communicable diseases necessitates concerned effort by scientists, policy makers and planners.

Coronary Heart Disease (CHD) has been defined as impairment of heart function due to inadequate blood flow to the heart compared to its needs caused by obstructive changes in the coronary circulation to the heart [1]. Therapeutic medicine is not the only solution and there is strong reason to support that environmental factors are of major importance in the chronic non-communicable diseases and therefore the prevailing epidemic of coronary heart disease is not an unavoidable consequence of economic development.

No disease has ever been conquered by an attempt to treat every affected individual. Using the epidemiological approach and by studying the aetiology only, man has succeeded in stamp out mass disease.

Apart from the use of mortality and morbidity statistics which has its own limitations the need of more direct evidence on causation directs the researcher to the population based study.

Clinical medicine and epidemiology differ from each another both in their strengths and limitations. The inferences that can be drawn from clinical observations are limited in following respects-

a. Patients of Coronary Heart Disease are usually seen when the illness has manifested itself, by which time pathology may be advanced and largely irreversible. Furthermore the occurrence of illness alters the patient. Eg. In an admitted case of Myocardial Infarction (MI) blood pressure may alter as a result of illness and cannot be a true epidemiological indicator.

b. Having determined the frequency of certain characteristics among patients such as type of family or family size, clinical observations provides no measure of how this differs from the frequency in the particular population from which these patients are drawn.

c. Hospital cases of coronary heart disease tend to be highly selected. Many patients die before reaching hospital while many do not come in hospital contact either due to illiteracy or poverty. This makes it impossible to generalize from hospital experience to the disease as it really exists in general population.

d. It is a well-known fact that no conclusion about prevalence and incidence rate of Coronary Heart Disease can be drawn from hospital studies and mere number of patients in hospital might be misleading.

All over India, a major number of people live in urban slums and Mumbai, a metro city has a large share in it. Such large population always go ignored due to the misconception that coronary heart disease is a disease of affluence, while poverty is no bar for CHD. Considering these facts an attempt has been made to study role of various factors influencing Coronary Heart Disease in an urban slum population.

**Aim and Objectives**

**Aim-** To study the epidemiology of Coronary Heart Disease in Urban Slum Population in Mumbai.

**Objectives**

- To study the various factors associated with Coronary Heart Disease in the age group of 25-64 years.
- To find out independent effect of multiple factors on occurrence of Coronary Heart Disease (CHD).
- To suggest recommendations on the basis of study findings.

**Methodology**

The present study was designed to be a case control study conducted in an urban slum community with a population of 35,967, served by Urban Health Centre, attached to the department of Preventive and Social Medicine of teaching institute. The community was established in 1977 as a resettlement colony, in the south east part of Mumbai. It is bound by Thane creek on its eastern border. It consists of a total 11 sectors of varying sizes, starting from 'A' sector up to 'K'. The 'F' sector is the largest in size and the 'K' sector is the smallest.

Each sector consists of a varying number of lines of kuchha or pucca houses, with houses in each row facing the opposite row of houses thus forming a pair. Most of the houses have maximum area of 10 X 15 square feet, comprising of a single room, with a 'mori' at one corner. Few houses have an additional floor. There are 20 common toilets for each sector and 2 common water taps for each line. The community has migration from Tamil Nadu, Kerala, Andhra Pradesh, Bihar, Uttar Pradesh and Maharashtra.

Since there are very few community based epidemiological studies of CHD in India, considering low prevalence rate of CHD and the need of large sample size [2], instead of taking the random sample, it was decided to cover the whole community by using door to door survey method. On the basis of evidence available in literature, study population was restricted to the age group of 25-64 years.

CHD was diagnosed if one or both of the following criteria were satisfied:

a. History of chest pain as assessed by the official English version of Rose Questionnaire to diagnose angina after excluding any obvious cause of pain due to local factors [3].

b. Myocardial Infarction (MI) based on complaint of typical severe chest pain. Documentary evidence of MI treated was insisted upon.

Effort was made to visit each and every authorised house, in serial order in each sector. A register was maintained in which number of persons in the age group of 25 to 64 years staying in the house was recorded age and sex wise. Those who had fulfilled the criteria for diagnosis of CHD were selected as cases

In this study Age and Sex, the two non-modifiable risk factors, were controlled. For this purpose once a case was diagnosed the next first person in serial order of the same age and same sex was selected as control if found not suffering from CHD on the basis of above mentioned criteria.

Being the most practical and economic tool, questionnaire method was used for data collection. A pre-structured, pretested proforma was prepared. The proforma was filled up only if the person was selected as a case or a control.

Proforma elicited information relevant to the coronary heart disease including Age, Sex, Religion, Marital Status, Education, Duration of Stay, Address, Type of Family, Occupation, Income, Family history of CHD and its risk factors, History of hypertension and Diabetes Mellitus and treatment taken for it, Dietary habits, Smoking, Alcohol consumption, Tobacco chewing etc.

Details of some important variable are as follows:

**Age**

Effort was made to find out the exact age in years using information available on Ration Card and asking relevant questions.

**Socioeconomic Status**

Being urban slum population per capita monthly income was used to determine socio-economic class as suggested by Gupta M.C., et al [4].

**Family History**

Family history of CHD or its risk factor was considered positive only if it was present in either of either parents or brothers or sisters.

**Physical Activity**

Physical activity was defined as light, moderate and heavy consistent with criteria recommended by expert Committee of WHO.

**Dietary Habits**

Twenty four hour recall method was used to assess the dietary habits of subjects. Special care was taken to estimate quantities of food consumed. Subjects were helped to estimate amounts by use of household measures and standard measures.

**Smoking**

Those who had ever smoked cigarettes or bidis regularly for more than one year were labelled as smokers. Variation in number of cigarettes or bidis was taken in consideration by asking detail history and maximum number and period as well minimum number and period were recorded.

**Alcohol Consumption**

Those who have ever consumed alcohol regularly for more than one year were labelled as Alcohol consumers. Information about period and frequency of drinking alcohol was obtained.

**Built**

Ectomorph (linear, asthenic), Mesomorph (bony, muscular) and Endomorph (round, fat).

**Hypertension**

Blood pressure was recorded using standard guidelines [3]. Blood pressure recording in the sitting position was selected for analysis. Hypertension was defined as a systolic Blood Pressure of 160 mm of Hg or more and/or a diastolic blood pressure (Phase V) of more than 95 mm of Hg or history of hypertension with regular current consumption of antihypertensive drugs.

**Obesity**

Obesity was estimated by using Body Mass Index (BMI) as suggested by WHO Expert committee [5].

**Fundoscopy**

Fundoscopy was done in all cases and controls except those having fully mature cataract. Pupils were dilated and Fundoscopy was done in comparatively darker room in Urban Health Centre. Grading of hypertensive retinal changes was done using Keith-Wagner-Barker classification.

**ECG Findings**

A 12 lead electrocardiogram at rest was obtained from all cases. Minnesota code was used for diagnosis of ischemia as follows: (a) Pathological Q: code 1-1-1 through 1-1-7 or code 1-2-1 through 1-2 -7 (b) Presence of major S. T. depression and/or a major T wave inversion in the absence of high voltage R wave code 4-1-1 and 4-1-2 and 5-1 and 5-2 [3].

Lab investigations done included Urine Sugar, Albumin and Microscopic examination, Haemoglobin, Fasting and Post Lunch Blood Sugar and Serum Cholesterol.

In addition complete analysis of drinking water was done by Municipal analyst in Public health Laboratory, Municipal Ward Office G (North).

Though this is a non-interventional study all the newly detected Hypertensive, Diabetics and CHD Coronary Heart Disease patients were treated and referred to different institute as per the subject's need. Cases were given health education about coronary heart disease. This was done on ethical basis. Incidentally it helped in gaining 100% response for investigations among cases.

The data was analysed on computer using SPSS package.

**Results and Discussion**

Out of 35,967 of total population of Cheeta Camp community 33.43% were in the age group of 25 to 64 years. Total numbers of 11,772 individuals in this age group were interviewed and 186 cases of Coronary Heart Disease (CHD) were registered. Equal numbers of controls were selected from the same population.

It is difficult to compare the results of previous epidemiological studies with present one due to:

a. Heterogeneity of population and different socio-cultural patterns existing in our country.

b. Different criteria used in defining CHD.

c. Need of large sample size to study epidemiology of Coronary Heart Disease (CHD).

d. The time difference between the various studies.

e. Predominance of lower socio-economic status in urban slum population.

The prevalence of CHD in Cheeta Camp was 15.80 per thousand in the age group of 25 to 64 years. In males it was 20.82 per thousand and in females it was 10.48 per thousand [6].

### Age and Sex Distribution of Cases and Controls

Among 186 cases 126 (67.7%) were males while 60 (32.3%) were females as seen in Table 1. Out of total, 95.2% of cases belonged to age group of 45-64 years and only 4.8% cases were in the age group of 25-44 years. Mean age of cases was 57.14 years ranging from 33 to 64 years. As the selection of controls was done by matching the age and sex in 1:1 proportion the age & sex distribution of the controls is exactly the same (Fig. 1).

*Table 1- Age & Sex Distribution of Cases / Controls*

| Age | Male | | Female | | Total | | Sex Ratio |
|---|---|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | Number | Percentage | Male:Female |
| 25-34 | - | - | 1 | 100 (1.7) | 1 | 100 (0.5) | - |
| 35-44 | 4 | 50.0 (3.2) | 4 | 50.0 (6.7) | 8 | 100 (4.3) | 01:01.0 |
| 45-54 | 15 | 46.9 (11.9) | 17 | 53.1 (28.3) | 32 | 100 (17.2) | 01:01.1 |
| 55-64 | 107 | 73.8 (84.9) | 38 | 26.2 (63.3) | 145 | 100 (78.0) | 01:00.4 |
| Total | 126 | 67.7 (100) | 60 | 32.3 (100) | 186 | 100 (100) | 01:00.5 |

*Figures in parenthesis indicate column percentage.*
*N=372, Cases- 186, Controls- 186.*

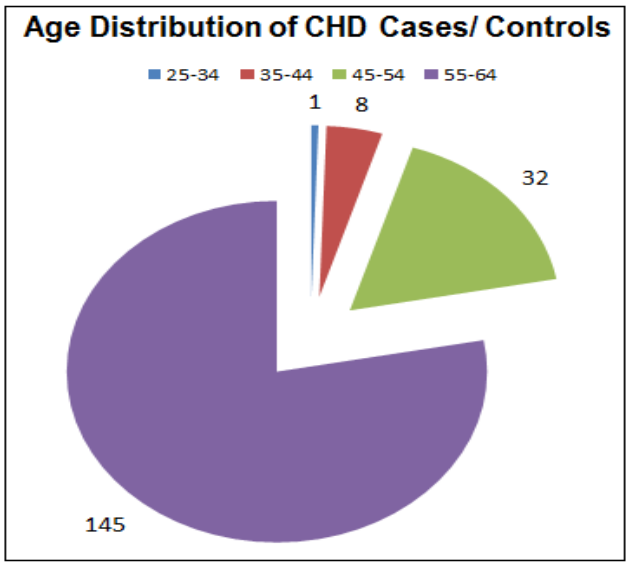


**Fig. 1-** Age Distribution of CHD Cases / Controls

### Religion

It was observed that majority of the cases (169/186: 90.9%) were Muslims and, the Hindu and the Christians were 14(7.5%) and 3 (1.6%) respectively. This is consistent with predominance of Muslim population in community. The controls comprise 173 (93%) Muslims, 12 (6.3%) Hindus and 1 (0.5%) Christian. Proportion of Hindus was more in cases, but there was no significant difference (P > 0.05) found statistically.

### Family and Marital Status

Mean duration of stay of the family in Cheeta camp was 14.6 years among cases while 14.8 years among controls. Majority of families, 116 (62.4%) in controls and 103 (55.4%) in cases were of extended joint type. Statistically there was no significant difference. (P > 0.05).

The average family size was 5.95 among cases while it was 5.44 among controls. There were only 28 (15.0%) controls whose family size was more than 6 while in 72 (38.7%) cases family size was more than 6 (Fig. 2). This difference was found significant (P < 0.001) statistically.

The family size has been found to be related with occurrence of CHD independently. This could be rather attributable to the increase in stress but needs further evaluation.

Study done by, Dandekar V.M. and Mitra A. showed that a large family is still looked upon as an asset by vast majority of households in the country [7,8]. This is believed to be economically advantageous, as well supposed to act as a shock absorber in the stress factors. Does it apply even to the Urban Slum population of lower socioeconomic status and what is the exact cause of relation between family size and CHD needs to studied further.

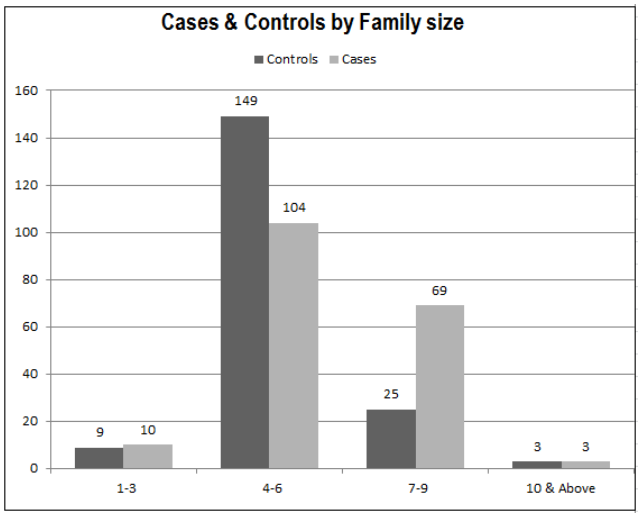


**Fig. 2-** Cases and Controls by Family Size

*Table 2- Cases & Controls by Marital Status*

| Marital Status | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column Percentage | Number | Column Percentage | Number | Column Percentage |
| Single | 7 | 3.8 | 21 | 11.3 | 28 | 7.5 |
| Married | 179 | 96.2 | 165 | 88.7 | 344 | 92.5 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square - 7.56977, df = 1, P = 0.00594*

Out of 186 cases 165 (88.7%) were married while 21 (11.3%) were single (unmarried, separated, widower or widow). The proportion of singles was more in comparison with controls (7, 3.8%) and found statistically significant (P < 0.01) as shown in Table 2. In the older age group widow or widowers are more usually. Significance indicated shows only presence of association and not the strength. Marital status had no independent relation with occurrence of CHD.

### Education and Income

Among the cases total number of Illiterates were 120 (64.5%), the 75 (62.5%) of which were males and 45 (37.5%) were females. The majority of illiterates i.e. 105 out of 120 were from age group of 55 to 64 years. Only 4 (2.2%) were graduates. The picture was similar in controls.

None of the controls had the monthly family income of Rs. 4000/- or more while 27 families among cases had the monthly family income more than Rs. 4000/-. In fact 5.9% of the total cases had monthly family income of Rs. 4500/- or more. Among 125 cases there was only 1 earning member in the family. While in 53 cases 2 and in 8 cases 3 earning members were there in family. Among controls these figures were 122, 54 and 10 respectively. Socio-economic Class (based on Per Capita Income) wise there was no significant difference (P > 0.05) among cases and controls as seen in Table 3.

*Table 3- Cases and Controls by Socio-Economic Class*

| Socio Economic Class | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column Percentage | Number | Column Percentage | Number | Column Percentage |
| Class V | 5 | 2.7 | 12 | 6.5 | 17 | 4.6 |
| Class IV | 120 | 64.5 | 123 | 66.1 | 243 | 65.3 |
| Class III | 61 | 32.8 | 47 | 25.3 | 108 | 29 |
| Class II | - | - | 2 | 1.1 | 2 | 0.5 |
| Class I | - | - | 2 | 1.1 | 2 | 0.5 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square = 8.73420, df = 4, P = 0.06810*

Padmavati, et al as well Chadda S.L., et al had found CHD more prevalent in higher socio-economic group [9,10]. In the present study the socio-economic status was determined only of the selected 372 subjects using Per Capita Income criteria. The high predominance of low socio-economic status in slum population is the limitation to draw a crystal clear conclusion.

**Occupation and Physical Activity**

As shown in Table 4 among controls 61 (31.2%) were manual labourers while in cases only 5 were working as manual labourers. This difference was significant statistically. (P < 0.001).

*Table 4- Occupation of Cases & Controls*

| Occupation | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| Clerical | 9 | 4.8 | 30 | 16.1 | 39 | 10.5 |
| Shopkeeper | 4 | 2.2 | 27 | 14.5 | 31 | 8.3 |
| Technical | 50 | 26.9 | 41 | 22 | 91 | 45.1 |
| Hawker | 3 | 1.6 | 27 | 14.5 | 30 | 8.1 |
| Housewife | 56 | 30.1 | 55 | 29.6 | 111 | 29.8 |
| Maidservant | 3 | 1.6 | 1 | 0.5 | 4 | 1.1 |
| Manual Labourer | 61 | 32.8 | 5 | 2.7 | 66 | 17.7 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square = 96.98648, df = 6 , P< 0.001*

The 45.7% controls had worked less than 9 hours per day while the proportion was 54.3% among cases. Among cases there were more people (84.1%) than controls doing sedentary type of work, while there were more controls (87.7%) than cases doing heavy type of work as shown in Table 5. This difference was significant statistically (P < 0.001). By using McNemar test forming pairs by 1:1 matching cases and controls it was found that relative risk of developing CHD was 9 times more in those who were doing moderate to heavy work as shown in Table 6.

Among cases only 6 (3.2%) had done one or other type of regular exercise in the past, while 81.2% (151) controls and 96.8% (180) cases had not done any extra physical exercise. The observed difference was significant (P < 0.001). With 1:1 matching and use of McNemar test the difference was found significant (P < 0.001) as shown in Table 6. The risk of those who had not done exercise was found 10.7 than those who had done.

The relationship between physical activity and the prevalence rate has been studied extensively by many workers and they reported that physical activity protects individual from the effect of CHD.

In epidemiological study of CHD in Gurgaon district sex wise prevalence in those who were doing heavy physical activity was found 8.0 in males and 5.5 in females. Among those who were engaged in light physical activity the respective figures were 13.8 and 8.3 per thousand. Present study supports these findings [11].

*Table 5- Cases & Controls by Type of work*

| Type of Work | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| Sedentary | 13 | 7 | 69 | 37.1 | 82 | 22 |
| Moderate | 109 | 58.6 | 108 | 58.1 | 217 | 58.3 |
| Heavy | 64 | 34.4 | 9 | 4.8 | 73 | 19.6 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square- 79.68687, df = 2, P< 0.001*

*Table 6- Distribution of Risk factors for CHD by Cases & Controls*

| Risk Factor for CHD | | | Cases | | Total | Chi Square (McNemar) | P | Odds Ratio |
|---|---|---|---|---|---|---|---|---|
| | | | Yes | No | | | | |
| Sedentary Work | Controls | Yes | 6 | 7 | 13 | | | |
| | | No | 63 | 110 | 173 | 43.2143 | 0 | 9 |
| | Total | | 69 | 117 | 186 | | | |
| Lack of Exercise | Controls | Yes | 148 | 3 | 151 | | | |
| | | No | 32 | 3 | 35 | 22.4 | 0 | 10.7 |
| | Total | | 180 | 6 | 186 | | | |
| History of CHD | Controls | Yes | 1 | 3 | 4 | | | |
| | | No | 38 | 144 | 182 | 28.1951 | 0 | 12.7 |
| | Total | | 39 | 147 | 186 | | | |
| Family history of 1 Risk factor (Smoking/ Obesity/ Hypertension/ Diabetes) | Controls | Yes | 98 | 25 | 123 | | | |
| | | No | 48 | 15 | 63 | 6.6301 | 0.01 | 1.92 |
| | Total | | 146 | 40 | 186 | | | |
| Hypertension | Controls | Yes | 18 | 4 | 22 | | | |
| | | No | 128 | 36 | 164 | 114.6136 | 0 | 32 |
| | Total | | 146 | 40 | 186 | | | |
| Diabetes Mellitus | Controls | Yes | 0 | 2 | 2 | | | |
| | | No | 17 | 167 | 184 | (Binomial) 2 tailed P = 0.0007 | | 8.5 |
| | Total | | 17 | 169 | 186 | | | |

**Family History**

The 21% of cases had given positive family history of CHD, while in controls only 2.1% had positive family history of CHD (Fig 3). When 186 pairs were formed by 1:1 matching of cases and controls, McNemar test showed significance (P < 0.001) as shown in Table 6. The relative risk was found 12.7 times more in those who had positive family history than who hadn't. Family history of CHD had shown independent relation with CHD.

Chadda S.L., et al found family history of CHD associated with occurrence of CHD. In that study 25.8% of subjects, 27.4% of males and 23.6% of females had given positive family history of CHD [10].

Though 111 (59.7%) of controls had given family history of at least one risk factor, only 6.4% had given family history of more than one risk factor, while in cases 79 (42.5%) had given history of having more than one risk factor in family as shown in Table 7. Difference

was found significant (P < 0.001). Odds ratio was found 1.92 when presence of any risk factor in family was considered for comparison between cases and controls.

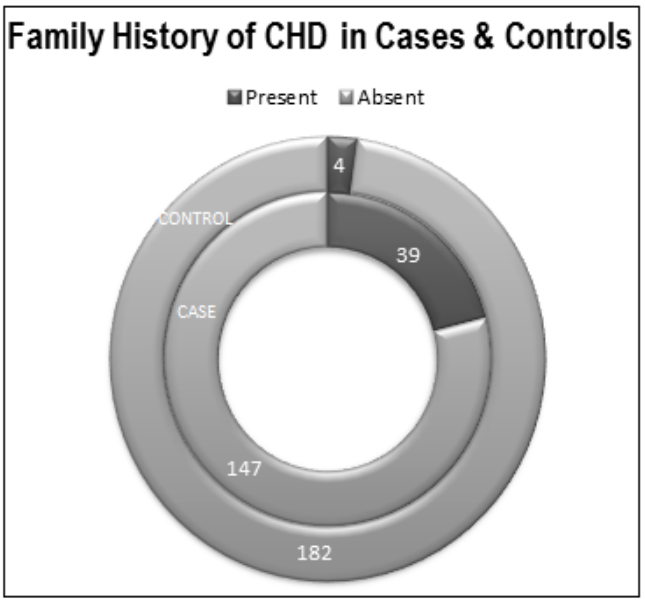


**Fig. 3-** Family History of CHD in Cases and Controls

*Table 7- Cases & Controls by Family History of Risk Factors**

| Family history of risk factors | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| No | 63 | 33.9 | 40 | 21.5 | 108 | 27.7 |
| One Factor | 111 | 59.7 | 67 | 36 | 178 | 47.8 |
| Two Factors | 11 | 5.9 | 61 | 32.8 | 72 | 19.4 |
| Three Factors | 1 | 0.5 | 14 | 7.5 | 15 | 4 |
| Four Factors | - | - | 4 | 2.2 | 4 | 1.1 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

**Smoking, Obesity, Diabetes, Hypertension*
*Chi Square- 66.00122, df = 4, P < 0.001*

### Hypertension

As it can be seen from Table 8, hypertensives were more among cases in both sexes in all age groups. In the age group of 55 to 64 years 81 males (75.7%) and 31 females (81.6%) were suffering from hypertension in comparison with 15 males and 7 females in controls. After 1:1 matching of cases and controls and forming 186 pairs, McNemar test showed significant difference (P<0.001) in two groups. The risk was 32 times more for those who were suffering from Hypertension as seen in Table 5.

*Table 8- Hypertension among Cases & Controls*

| Age Group | Controls | | | | Cases | | | |
|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | Male | | Female | |
| | HT | Non-HT | HT | Non-HT | HT | Non-HT | HT | Non-HT |
| 25-34 | - | - | - | 1 (100) | - | - | 1 (100) | - |
| 35-44 | - | 4 (100) | - | 4 (100) | 4 (100) | - | 3 (75.0) | 1 (25.0) |
| 45-54 | - | 15 (100) | - | 17 (100) | 11 (73.3) | 4 (26.7) | 15 (88.2) | 2 (11.8) |
| 55-64 | 15 (14.0) | 92 (86.0) | 7 (18.4) | 31 (81.6) | 81 (75.7) | 26 (24.3) | 31 (81.6) | 7 (18.4) |
| Total | 15 (11.9) | 111 (88.1) | 7 (11.7) | 53 (88.3) | 96 (76.2) | 30 (23.8) | 50 (83.3) | 10 (16.7) |

*Figures in parenthesis indicate row percentage sex wise.*

The mean systolic blood pressure of CHD cases was 161.8 mm of Hg (SD-18.4 & SE-1.35) while mean diastolic blood pressure was 97.6 mm of Hg (SD-10.3 & SE-0.76). Among controls the mean systolic blood pressure was 127.3 mm of Hg (SD-14.8 & SE-1.08) while mean diastolic blood pressure was 81.8 mm of Hg (SD - 8.3 & SE-0.61).

Majority of cases (101-54.3%) were having systolic blood pressure in the range of 160 -179, while majority of controls (98-52.7%) were having systolic blood pressure in the range of 120 to 139. (Fig. 4) This difference was significant statistically. (P < 0.001).

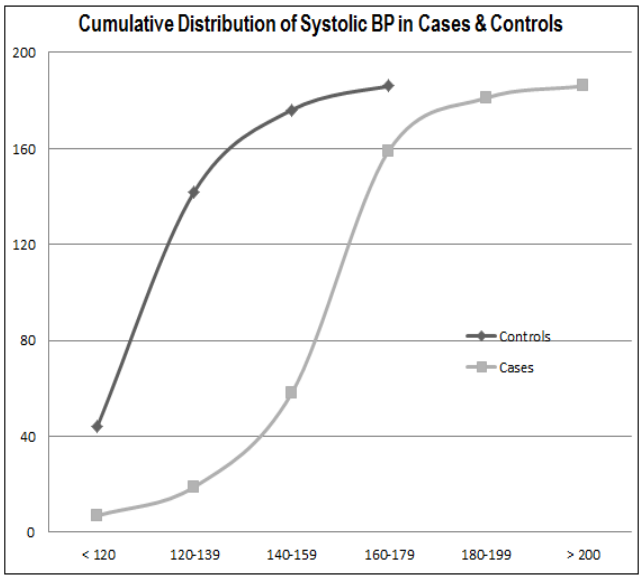


**Fig. 4-** Cumulative Distribution of Systolic BP in Cases and Controls

Majority of controls (164-88.2%) were having diastolic blood pressure less than 90 mm of Hg while only in 41 cases ( 22.0%) the diastolic blood pressure was less than 90 mm of Hg. Observed difference was significant statistically. (P < 0.001) However systolic rather than diastolic blood pressure was more strongly related independently.

In epidemiological study of CHD in Delhi, hypertension emerged as the strongest associated risk factor in CHD in both sexes [10]. The 43.8% of subjects, 42.1% of males and 46.2% of females were having hypertension.

### Diabetes Mellitus

The Table 9 shows that 6 males (4.8%) and 11 females (18.3%) were suffering from Diabetes among cases while only 1 male (0.8%) and 1 female (1.7%) were suffering from it. The mean fasting blood sugar level was 104.4 (SD - 27.8 SE - 2.03) while mean post lunch sugar was 142.6 (SD-40.0 SE-2.93) among cases. Among controls, the mean fasting blood sugar level was 93.9 (SD-13.4 SE-1.04 N -164) while mean post lunch sugar was 132.3 (SD-12.6 SE - 0.99 N - 160).

Only 5.5% of controls had fasting blood sugar levels above 120 mg/dl while 11.9% cases fasting blood sugar was above 120 mg/dl. The observed difference was statistically significant (P < 0.001). Post lunch blood sugar was below 160 mg/dl in majority of controls and cases i.e. 155 (96.9%) and 159 (85.5%) respectively.

*Table 9- Diabetes Mellitus among Cases & Controls*

| Age Group | Controls | | | | Cases | | | |
|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | Male | | Female | |
| | DM | Non - DM | DM | Non - DM | DM | Non - DM | DM | Non - DM |
| 25-34 | - | - | - | 1 (100) | - | - | - | 1 (100) |
| 35-44 | - | 4 (100) | - | 4 (100) | 2 (50.0) | 2 (50.0) | - | 4 (100) |
| 45-54 | - | 15 (100) | 1 (5.9) | 16 (94.1) | 2 (13.3) | 13 (86.7) | 4 (23.5) | 13 (76.5) |
| 55-64 | 1 (0.9) | 106 (99.1) | - | 38 (100) | 2 (1.9) | 105 (98.1) | 7 (18.4) | 31 (81.6) |
| Total | 1 (0.8) | 125 (99.2) | 1 (1.7) | 59 (98.3) | 6 (4.8) | 120 (95.2) | 11 (18.3) | 49 (81.7) |

*Figures in parenthesis indicate row percentage sex wise.*

Chadda S.L., et al found relationship of diabetes with CHD. Among the 15.8% of clinically diagnosed CHD cases, 17.5% males and 13.4% females were suffering from diabetes [10].

**Ear Lobe Crease**

In many studies it was found that ear lobe crease, hair in ear and baldness were incidentally associated with CHD. But many of these studies are hospital based and to date no population based epidemiological study has been taken to find the causal relationship [12].

As Table 10 shows ear lobe crease was present in 34 (18.3%) controls and 71 (38.2%) cases. The difference was found significant statistically (P < 0.001). The presence of ear lobe crease is due to deposition of fat and rather related with obesity. Though in present study Chi Square test was significant, it failed to show independent association which is more important to establish a new factor as a risk factor.

*Table 10- Cases & Controls by Ear Lobe Crease*

| Ear Lobe Crease | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| Absent | 152 | 81.7 | 115 | 61.8 | 267 | 71.8 |
| Present | 34 | 18.3 | 71 | 38.2 | 105 | 28.2 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square- 18.16544, df = 1, P = 0.00002*

**Obesity, Cholesterol and Diet**

Among controls no one was obese though 14 (7.5%) had BMI values above normal; while in cases 13 (7.0%) were obese. Among cases in 53 males (42.1%) Body Mass Index values were above normal while 1 (0.8%) was obese. In females 7 (11.7%) had BMI values above normal but 12 (20%) were obese. (Fig.5)

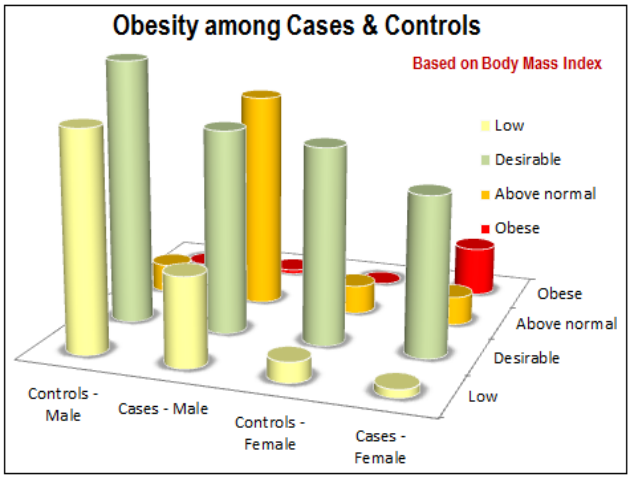


**Fig. 5-** Obesity among Cases and Controls

Chadda S.L., et al had used weight above 10% of expected weight (as decided by LIC India) as criteria for obesity and found obesity related with CHD. In their study 42% of those who had a heart problem were obese, while just 30% of obese were happily fat without a heart problem [10].

Among cases cholesterol levels were high. The 73% of cases were having cholesterol levels above 240 mg/dl while only 13.4% controls were having cholesterol levels above 240 mg/dl. (Fig. 6) The observed difference was significant statistically (P < 0.001).

The mean total cholesterol of the cases was 255.30 (SD-41.1 SE-3.0) while of the controls was 197.96 (SD-34.2 SE-2.5). Chadda S. L. had found cholesterol more than 200 mg/dl in 30% of CHD cases [10].

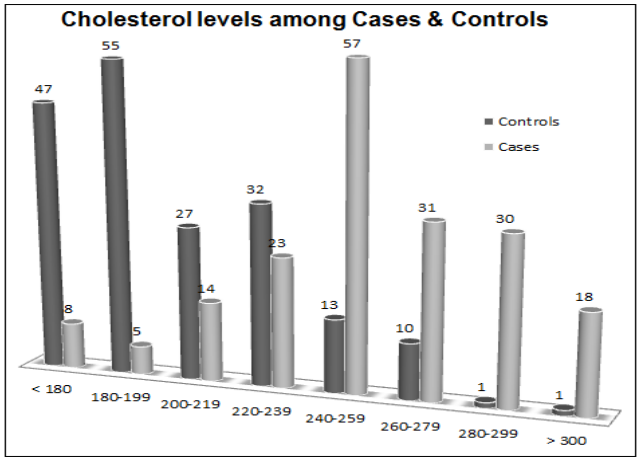


**Fig. 6-** Cholesterol levels among Cases and Controls

The 51 cases (27.4%) were receiving 2800 or more calories through daily diet and 40 (21.6%) cases were receiving less than 2400 calories through daily food. Among the same caloric groups proportion in controls was 17.7% and 67.1% respectively. The observed difference was significant statistically. (P < 0.005)

As the Table 11 shows in majority of cases i.e. 133 (71.6%) more than 20% of calories of the total caloric intake were derived from fat. But only 3.8% cases were eating fats amounting 30% or more of total calories. In controls the corresponding figures were 82 (44.1%) and 2.7% respectively. The observed difference was significant statistically (P < 0.001).

*Table 11- Cases & Controls by Percentage of Fat Calories in Diet*

| Percent of Fat Calories | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| Below 15 | 18 | 9.7 | 22 | 11.8 | 40 | 10.8 |
| 15-19 | 86 | 46.2 | 31 | 16.7 | 117 | 31.5 |
| 20-24 | 35 | 18.8 | 92 | 49.5 | 127 | 34.1 |
| 25-29 | 42 | 22.6 | 34 | 18.3 | 76 | 20.4 |
| 30 & Above | 5 | 2.7 | 7 | 3.8 | 12 | 3.2 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square - 53.01282, df = 4, P< 0.001*

Out of 186 cases, 101 (54.3%) had habit of taking additional salt in diet while among controls out of 186, 50 (26.9%) were taking extra salt in diet. The observed difference was significant (P < 0.001) statistically.

However all these factors failed to show independent relation with Coronary Heart disease (CHD).Considering limitations of 24 hour recall survey method of dietary survey included in the study, it needs further evaluation.

**Smoking, Alcohol Consumption and Tobacco chewing**

Among cases 66.7% (124) were smokers while among the controls 58.1% (108) were smokers. Observed difference was not significant (P > 0.05).

An attempt was made to estimate the number of bidis and/or cigarettes smoked by the person over the years based on frequency and variation in frequency on history. As shown in in Table 12, 48.4% cases had smoked more than 3 lakh cigarettes or bidis while only 20.5% controls had smoked that much number of bidis or cigarettes. The observed difference was statistically significant (P < 0.001).

*Table 12- No. of Bidis / Cigarettes smoked by Cases & Controls*

| No. of Bidis and / or Cigarettes | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| Up to 50,000 | 7 | 6.5 | 2 | 1.6 | 9 | 3.9 |
| Up to 1.0 Lac | 11 | 10.2 | 2 | 1.6 | 13 | 5.6 |
| Up to 1.5 Lac | 12 | 11.1 | 6 | 4.8 | 18 | 7.8 |
| Up to 2.0 Lac | 25 | 23.1 | 24 | 19.4 | 49 | 21.1 |
| Up to 2.5 Lac | 18 | 16.7 | 8 | 6.5 | 26 | 11.2 |
| Up to 3.0 Lac | 13 | 12 | 22 | 17.7 | 35 | 15.1 |
| Up to 3.5 Lac | 3 | 2.8 | 28 | 22.6 | 31 | 13.4 |
| Up to 4.0 Lac | 9 | 8.3 | 9 | 7.3 | 16 | 7.8 |
| Up to 4.5 Lac | 6 | 5.6 | 6 | 4.8 | 12 | 5.2 |
| Up to 5.0 Lac | 2 | 1.9 | 15 | 12.1 | 17 | 7.3 |
| Above 5 Lac | 2 | 1.9 | 2 | 1.6 | 4 | 1.7 |
| Total | 108 | 100 | 124 | 100 | 232 | 100 |

*Chi Square- 46.40915, df = 10, P< 0.001*

In epidemiological study of CHD in Delhi smoking did not show independent association with CHD, though it was present in 36.5% males and 5.9% females [10]. The criteria used was, person smoking 10 cigarettes per day for two years or more at the time of survey.

Among cases there were 58 (31.2%) alcohol consumers while among controls 53 (28.5%). There was no significant statistical difference found among two groups.

As seen in Table 13 among cases 103 (55.4%) were tobacco chewers while among controls 84 (45.2%). The observed difference among two groups was significant statistically (P < 0.05). It had also shown independent relation and needs further evaluation.

*Table 13- Tobacco chewing among Cases & Controls*

| Tobacco Chewing | Controls | | Cases | | Total | |
|---|---|---|---|---|---|---|
| | Number | Column % | Number | Column % | Number | Column % |
| Absent | 102 | 54.8 | 83 | 44.6 | 185 | 49.7 |
| Present | 84 | 45.2 | 103 | 55.4 | 187 | 50.3 |
| Total | 186 | 100 | 186 | 100 | 372 | 100 |

*Chi Square- 3.88183, df = 1, P= 0.04881*

**ECG Findings**

On electrocardiogram (ECG) definite changes of ischemia were found in 93 (50.0%) cases. Ischemia was found in 63 (33.9%) cases and Infarct in 30 (16.1%).

In 62 (33.3%) cases ECG was within normal limits while Left Ventricular Hypertrophy (LVH) was found in 26 (14.0%) cases and conduction defects in 5 (2.7%) cases in absence of definitive changes of ischemia.

*Table 14- Variables having Independent effect* on CHD*

| Step No. | Variable | Significance (P) |
|---|---|---|
| 1 | Systolic blood Pressure | 0 |
| 2 | Cholesterol | 0 |
| 3 | Built | 0 |
| 4 | Type of Work | 0 |
| 5 | Family History of CHD | 0 |
| 6 | Diastolic Blood Pressure | 0.0028 |
| 7 | Family size | 0.0415 |
| 8 | Smoking | 0.0118 |
| 9 | Diabetes Mellitus | 0.0279 |
| 10 | Tobacco Chewing | 0.0326 |

**As found by stepwise multiple regression using SPSS/PC+*

**Fundoscopy Findings**

Fundoscopy was not possible in 32 cases (17.2%) due to cataract. In 74 cases (39.8%) findings were normal. In 41 cases (22.0%) there were Grade-I Hypertensive changes, in 29 (15.6%) Grade-II, in 6 (3.2%) Grade-III and in 1 case (0.5%) Grade-IV changes. In 3 cases (1.6%) there were Diabetic changes.

**Softness of Water**

*Table 15- Water sample analysis*

| S. No. | Chemical Examination | mg / L |
|---|---|---|
| 1 | Hardness (Total) | 76 |
| 2 | EDTA Method - Permanent | 16 |
| 3 | As CaCO3 - Temporary | 60 |
| 4 | Dissolved Solids | 85.6 |
| 5 | Total Solids | 92.4 |
| 6 | Calcium | 14.4 |
| 7 | Magnesium | 9.7 |
| 8 | Sodium | 5.96 |
| 9 | Iron | 0.18 |
| 10 | Silica | 6.8 |
| 11 | Carbonate | 36 |
| 12 | Sulphate | 4 |
| 13 | Chloride | 16 |
| 14 | Nitrate | 0.44 |

*From Report of Municipal Lab*

Softness of water is considered as a risk factor [13] for Coronary Heart Disease (CHD). In the present study complete analysis of water was done to find out level of hardness of water.

As shown in Table 15 it was found that hardness of water was 76 mg/L which is safe level. All the subjects mentioned that they drink raw tap water only and few of them boil it only in rainy season.

**Conclusion and Recommendations**

The present case-control study indicates that among multiple risk factors of Coronary Heart Disease Systolic Blood Pressure, Cholesterol, built, Type of work, family history of CHD, Diastolic Blood Pressure, Family size, Smoking, Diabetes Mellitus and Tobacco chewing are having significant independent effect even in urban slum population having predominantly low socio-economic status.

It was found that:

i. Religions do not have any influence on occurrence of CHD (P > 0.05).

ii. CHD is more common among singles (including unmarried, separated, widow and widower) than married (P < 0.01). This needs further evaluation.

iii. Type of family does not have any influence on occurrence of CHD (P > 0.05).

iv. Risk of suffering from CHD was found more in large families. (P < 0.001). It found to have even independent effect. Though this could be attributable to stress, needs further evaluation.

v. Per Capita Income failed to show significant association with occurrence of CHD (P > 0.05).

vi. Sedentary type of work is significantly associated with Coronary Heart Disease (P < 0.001). The association is independent.

vii. A significant association between the habit of doing regular physical exercise in the past and absence of CHD was found. (P < 0.001).

viii. Family history of CHD is significantly related with occurrence of CHD (P < 0.001). The relation is independent.

ix. Presence of any one risk factor (smoking, obesity, hypertension, diabetes mellitus) in family is related with occurrence of CHD significantly (P < 0.001), though it does not have independent relation.

x. Presence of Hypertension and /or Diabetes Mellitus has significant (P < 0.001) as well as independent association with CHD.

xi. Both systolic and diastolic blood pressure has independent effect on occurrence of CHD. But the systolic blood pressure is the most decisive risk factor.

xii. Ear lobe crease is only incidental finding having significant association (P < 0.001) with CHD but no independent relation.

xiii. Obesity is associated with CHD significantly (P < 0.001). It do not have independent association in terms of body mass index but built of person is independently related with CHD. This needs further evaluation.

xiv. Cholesterol levels have significant association with occurrence of CHD (P< 0.001) as well independent association ranking next to systolic blood pressure.

xv. Occurrence of CHD depends on number of bidis and /or cigarettes smoked (P < 0.001) rather than presence or absence of smoking. Smoking has independent effect.

xvi. Alcohol failed to show significant association (P > 0.05) both in quantity as well by consumption criteria.

xvii. Tobacco chewing was associated with occurrence of CHD significantly (P < 0.05). It had minimal independent effect among the factors having independent effect on occurrence of CHD.

xviii. Dietary factors like high caloric intake ( P < 0.01), high fat content of diet ( P < 0.001) and extra salt in diet ( P < 0.001) are significantly related with CHD but failed to show independent effect.

In view of these findings and in order to combat this newly emerging Public Health Problem, a multipronged attack need to be launched at multiple levels, considering Prevention is the best solution.

Prevention should start in childhood on pathological and behavioural grounds, since this is the time when-

i. Atherosclerotic and hypertensive disease process starts.

ii. Life style and habits are formed.

Given the importance of applying prevention strategies early in life, schools and youth education programmes can be important focus for prevention activities. Parents as well as schools can play a crucial role, as can older peers and recreational organizations. In prevention programmes directed at schools the initial efforts must be much innovative and of high quality.

Health educational programmes should include knowledge about risk factors and behaviour change communication for avoidance of CHD through healthy life styles. (e.g. inception of exercise or avoidance of smoking, etc.).

In community also educational programmes must be planned as a sequence and must be based on definite goals.

Informal opinion leaders can be identified and trained in a systematic way. Emphasis can be given on the people known to have CHD or Hypertension, who can act as motivators in turn.

Furthermore use of mass media can enhance community participation and improve dissemination of much needed information. It can also demonstrate appropriate behaviour and teach skills needed to achieve behavioural changes. Use of mass media along with sustained personal reinforcement over a long period can definitely help effectively to curb the widely spreading disease.

Hypertension and Diabetes Mellitus, the two condition having independent influence on occurrence of CHD, their prevention primary as well secondary should be integral part of coronary heart disease prevention.

Early detection and proper treatment of hypertension and diabetes can help in controlling or delaying the onset of CHD. Along with provision of health clinic a “Hypertension Clinic: must be an integral part of community health centre. The hypertension clinic staff must consist, a medical social worker, a physician with experience of minimum 6 months in cardiology and at least one community health worker. All the newer more effective drugs and needed instruments as well facility for simple routine investigations should be available. Non pharmacological means of treating hypertension should also be stressed upon. More importance needs to be given to traditional age old Indian methods, Yoga and Meditation.

Enough importance to topics of Hypertension and Coronary Heart Disease should be given in Medical curriculum of undergraduates.

The large community based epidemiological studies is the need of time. It will help the policy makers to chalk out programmes to minimize the extent of the problem of CHD.

**Limitations of the Study**

A community based case-control study with retrospective collection of data possesses some inherent limitations and present study was no exception.

Though effort was made to cover large population, it was not feasible to cover population larger than this.

Matching was limited to only age and sex two non-modifiable risk factors. It is possible that incorrect information about age might have received in few subjects though effort was made to obtain exact age. This will have some effect on matching.

Due to practical limitations matching was restricted to 1:1. The numbers of cases were 186 and equal numbers of controls were included in study. Though controls were selected randomly, 186 is a very small number and might not represent normal distribution of certain characteristics of population.

The 24 hour recall method of dietary survey is simple, direct and inexpensive method that can be used with subjects to different background and educational level for estimation of intake. But accuracy depends on the ability of the subject to remember what food was eaten and to estimate portion size. This method has been shown to underestimate intake when compared with other method.

Controls being symptomatic, universal compliance for blood sugar investigations could not be achieved.

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