

Risk Factors for Coronary Artery Disease

(An Epidemiological Study)

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SUMMARY

Coronary risk profile screening was performed in 251 patients with myocardial infarction and unstable angina admitted to the Sheikh Zayed Hospital, C.C.U. during consecutive 15 months. Mean age was 56.3 years (male : 55.6 years, female :59 years). Male patients were absolutely greater in number almost 5 times of female patients. Moreover males began to suffer the disease at younger age. 60.8% were in the age group of 40-60 years, whereas 81.6% female cases were 50 and above. Sedentary life style (62.2%), low HDL cholesterol (<35 mg/dl), (58.1%) total cholesterol/HDL-C ratio more than 5 (59.7%) were the most common risk factors for both sexes. A large number of males gave the history of current smoking (56.9%) whereas only 2.3% females were smokers. In women the prevalence of hypercholesterolemia (57.1%) hypertension (57%) and diabetes mellitus (38%) was higher compared with men (28%, 14.3%, 18.2% respectively. (fig 4). Family history of ischemic heart disease was reported by 30.6% of patients. 43.4% reported stressful life style. Majority of the cases (60.9%) belonged to low to low middle class. and were urban dwellers. Hypertriglyceridemia and hyperuricemia were found in 16.7% and 37% cases respectively. 11% patients were free of the major risk factors reviewed. This study shows that hypercholesterolemia, hypertension and diabetes mellitus are not the most common predisposing factors of IHD in our patients. Instead low HDL-C, total cholesterol/ HDL-C > 5 and sedentary life style appear more important. The high prevalence of smokers in our patients population indicates the need for a more effective antismoking campaign in Pakistan.

INTRODUCTION

Ischemic heart disease commonly due to atherosclerosis is on the rise in Pakistan like in other developing countries¹. Statistics are not available in our country about the incidence and prevalence of the disease but it is the general impression of clinicians all over the country that incidence of IHD is rapidly increasing and is mainly affecting young and middle aged group. To have an idea about the prevalence of IHD in our population, we analyzed the statistics of Sheikh Zayed Hospital, during the period from September 1986 to June 1988. During that period out of total 6355 admissions in the division of Medicine 1153 had angina or myocardial infarction (18.1%).

Extensive work has been done in the Western countries on prevalence of ischemic heart disease and factors predisposing to it. Insufficient

epidemiological data exist concerning the actual prevalence of the disease and its known risk factors in Pakistan. A detailed study was done in 1980². Some work has been done on lipid profile of acute MI patients³⁻⁵. But the results of these studies are not consistent and they do not have statistical power. It is important to have local data on the risk factors for primary prevention of IHD^{1,6}. Reports from other developing countries indicate that prevailing risk factors appear to be different than in the West⁷⁻⁹. A study was conducted at Sheikh Zayed Hospital Lahore with the following objectives.

OBJECTIVE OF STUDY

- * To detect risk factors predisposing to ischemic heart disease in Pakistan.
- * Whether these risk factors differ from those reported in the U.S. and Europe.

MATERIALS AND METHODS

The study included all the patients admitted to the C.C.U./Cardiology ward with the diagnosis of acute myocardial infarction or unstable angina during 15 months from December 1988 to February 1990. Acute myocardial infarction was diagnosed if 2 of the 3 criteria shown in Table 1 were fulfilled. For unstable angina typical history was the sole criterion. Based on the above criteria out of 251 study patients 169 (67.33%) were diagnosed as cases of acute MI and 82 (32.66%) patients were diagnosed as cases of unstable angina (Table 2). A detailed performa was filled for each patient which included a complete medical/personal/ social and family history. Physical examination comprised measurement of blood pressure, height, weight, waist and hip girth. Waist to hip girth ratio $> 1^{10}$ and 20% excess over ideal weight of Metropolitan life and insurance height and weight tables 1983¹¹ were taken as risk factors of IHD¹².

Table 1: Criteria for the diagnosis of myocardial infarction.

1. Typical chest pain
2. Significant Q waves (0.04 secs or 25% of the R wave in at least 2 contiguous leads).
3. Typical enzyme changes.

Table 2: Incidence of the diagnostic criteria in the patients studied.

| | <u>Total number = 251</u> | |
|--|---------------------------|---------|
| | Number | Percent |
| Unstable angina [#] | 82 | 32.66 |
| Acute Myocardial Infarction | 169 | 67.33 |
| Acute MI cases (n=169) | | |
| All 3 criteria positive [*] | 122 | 72.18 |
| Typical chest pain + typical enzyme changes | 18 | 10.65 |
| Typical chest pain + significant Q waves | 25 | 14.8 |
| Significant Q waves + typical enzyme changes | 4 | 2.37 |

[#]Typical history was the sole diagnostic criterion for unstable angina.

^{*}Three diagnostic criteria of acute MI are described in Table 1.

Laboratory data included measurement of serum total cholesterol¹³, low density lipoprotein cholesterol¹⁴, high density lipoprotein cholesterol¹⁵, triglyceride¹⁶, uric acid¹⁷ and blood glucose¹⁸ by the standard enzymatic methods in our hospital laboratory. 12 hours fasting venous samples were taken within 24- 48 hours of admission.

Serum total cholesterol levels of < 200 mg/dl, 200-239 mg/dl and 240 mg/dl and LDL cholesterol levels of < 130 mg/dl, 130 - 159 mg/dl and > 160 mg/dl were classified as desirable, borderline and high respectively irrespective of age according to the National Institute of Health National Cholesterol Education Programme (NIH-NCEP)¹⁹.

In accordance with the recommendation of NCEP 1988²⁰ and European Atherosclerosis Society²¹ HDL cholesterol < 35 mg/dl was taken as a risk factor. Total cholesterol HDL cholesterol ratio > 5 was used to identify individuals at high risk^{22,23}. Hypertriglyceridemia was diagnosed if serum triglycerides level was > 200 mg/dl²¹. Cut off value for serum uric acid was taken as 7 mg/dl.

RESULTS

Age and Sex Distribution

Total patients were 251 out of these 209 were men (83.3% and 42 were women (16.7%). Male to female ratio was 4.97:1 (Table 3). Table 4 shows age distribution in the total cases and according to sex. Maximum number of patients were in the age group of 41 - 60 years (58.8%). Patients aged 40 and below were 10.7%. Total mean age was 56.63 years with the age range of 28 to 85 years. Men suffered ischemic heart disease at younger age than women. Maximum number of males (n=127; %=60.8) were in the age group of 41 - 60 years, whereas maximum number of females were in the age group of 51 - 70 years (n=29; %=72.1%). Percent of men and women 40 and below were 11.9 and 7.1 respectively. Four men were in the age group of 21 - 30 years (1.9%) but none of the women. Mean age for men was 55.6 years and for women it was 59 years.

Marital Status

Majority of our patients were married (87%). Single were only 1.5% and widowed are 9.6% (Table 5). Fourteen out of 209 men (6.6%) and 10 out of 42 women (23.8%) were widowed.

Table 3: Sex Distribution.

| | Total number = 251 | |
|---------------|--------------------|---------|
| | Number | Percent |
| Men | 209 | 88.3 |
| Women | 42 | 16.7 |
| Male : Female | 1 | 4.97 |

Living District

Most of the cases hailed from urban areas. Total 196 (78%) were urban dwellers and 55 (22%) were rural dwellers. Out of 55 only 15 patients (5.9% of the total) were still living in rural areas. The rest had migrated to cities 5 to 40 years ago.

Table 4: Number and percent of patients in different age and sex groups.

| Age Group (Years) | Total (n=251) | | Male (n=209) | | Female (n=42) | |
|-------------------|---------------|------|--------------|------|---------------|------|
| | No. | % | No. | % | No. | % |
| 21-30 | 4 | 1.6 | 4 | 1.9 | 0 | 0 |
| 31-40 | 23 | 9.1 | 21 | 10 | 3 | 7.1 |
| 41-50 | 67 | 26.6 | 61 | 29.2 | 6 | 14.3 |
| 51-60 | 81 | 32.2 | 66 | 31.8 | 15 | 38.8 |
| 61-70 | 58 | 23.1 | 43 | 20.6 | 14 | 33.3 |
| 71-80 | 14 | 5.8 | 11 | 5.26 | 3 | 7.1 |
| 81-90 | 4 | 1.6 | 3 | 1.44 | 1 | 2.4 |

Total Mean age = 56.3 years
 Range = 25 - 85 years
 Mean age for men = 55.6 years
 Mean age for women = 59 years

Table 5: Marital status.

| | Total number = 251 | |
|------------|--------------------|---------|
| | Number | Percent |
| Married | 219 | 87.2 |
| Single # | 4 | 1.6 |
| Widowed * | 24 | 9.6 |
| Divorced + | 4 | 1.6 |

All single were males
 * 14 widowed were males. 10 widowed were females
 + All divorced were males

Socio-economic Status

Socio-economic status of the patients has been shown in table 6. Over 50% of the cases (61.5%)

belonged to low to low middle social class. Patients in high income group were 26.3%.

Those with more than 5 children or dependents constituted 37% of the total whereas 32.3% lived in the joint family system.

Education

Table 7 shows educational status of this group. Most of them (88%) were literate, 12% were illiterates. Out of 88% literates 35% had secondary education, 29.5% had college education upto F.A. or B.A. and 13% were postgraduates. However these results are biased as the hospital serves a specific locality and the sample is not representative of the whole population.

Table 6: Distribution of patients in various income groups.

| Annual income in rupees | Total number = 251 | |
|--------------------------------|--------------------|---------|
| | Number | Percent |
| < 30,000 | 99 | 39.44 |
| > 30,000 < 50,000 | 54 | 21.51 |
| > 50,000 < 100,000 | 32 | 12.75 |
| > 100,000 | 66 | 26.29 |
| Children/dependents > 5 = 37 % | | |
| Joint family system = 32.3 % | | |

Table 7: Education.

| | Total number = 251 | |
|--|--------------------|---------|
| | Number | Percent |
| Illiterate | 30 | 11.95 |
| Literate | 221 | 88.05 |
| Education Status of literates (n = 221) | | |
| Those who could read or write their name | 20 | 9 |
| Primary # | 28 | 13.5 |
| Secondary * | 77 | 35 |
| College + | 65 | 29.5 |
| Postgraduate \$ | 29 | 13 |

upto 5th class
 * upto Matric
 + F.A. or B.A.
 \$ M.A., M.Sc., LLB, Engineer, Doctor.

Occupation

Percent distribution of male patients who were private/government employees and self employed was 45% and 40.6% respectively. Twelve percent of

men were retired and only 2.4% were jobless. Majority of the females (90.4) were housewives. Of the remaining 4.8% were doing jobs and 4.8% were retired government employees. Occupational grouping is evident in Table 8.

Stressful Life Style

No objective criteria were used for assessment of stress. Instead assessment was based on subjective experience of the stress as reported by the patients. Stressful life style was reported by 43.4% of total individuals with ischemic heart disease. According to 23.5% patients their life was very stressful whereas 19.9% of them reported it as stressful as shown in Table 9.

Table 8: Occupational groups.

| Men | Men n = 209 | | Women n = 42 | | |
|------------------------|-------------|------|--------------|----|------|
| | No. | % | No | % | |
| Private/Govt Employees | 91 | 45 | House wives | 38 | 90.4 |
| Self employed | 85 | 40.6 | Employed | 2 | 4.8 |
| Retired | 25 | 12 | Retired | 2 | 4.8 |
| Jobless | 4 | 2.1 | | | |

Table 9: Number and percent of patients who reported stressful life-style.

| Life style | Total number = 251 | |
|----------------|--------------------|---------|
| | Number | Percent |
| Very Stressful | 59 | 23.5 |
| Stressful | 50 | 19.9 |

Leisure Time Physical Activity

A large percentage of women (83.9%) and men (57.4%) had sedentary habits. Only 23.4% men did regular moderate exercise (defined as exercise at least 5 times/week. 15 minutes each time making the person sweat). Not a single woman with ischemic heart disease in this study group did regular moderate exercise (Table 10). But these results are biased as study sample was small.

Obesity and Fat Distribution

Total 13.1% of the study patients were obese. Only 10.5% of 209 males and 26.1% of 42 females

had 20% excess over ideal weight. Waist to hip girth ratio > 1 also does not seem to be important as a risk factor in this population. Waist to hip girth ratio more than 1 was noted in 19.6% men and 16.6% women. (Table 11; Fig. 4).

Table 10: Leisure time physical activity.

| Exercise Level | Total (n=251) | | Men (n=209) | | Women (n=42) | |
|---------------------------|---------------|------|-------------|------|--------------|------|
| | No. | % | No. | % | No. | % |
| Secondary | 156 | 62.2 | 120 | 57.4 | 35 | 83.3 |
| Irregular mild exercise | 46 | 18.3 | 40 | 19.2 | 7 | 16.7 |
| Regular moderate exercise | 49 | 19.5 | 49 | 23.4 | 0 | 0 |

Table 11: Obesity and distribution in men and women with IHD

| | 20 Percent excess over ideal weight # | | |
|----------|---------------------------------------|-------------|--------------|
| | Total (n=251) | Men (n=209) | Women (n=42) |
| Number | 33 | 22 | 11 |
| Percent | 13.1 | 10.5 | 26.1 |
| WHR > 1* | | | |
| Number | 48 | 41 | 7 |
| Percent | 19.1 | 19.6 | 16.6 |

#Ideal weight according to Metropolitan height & weight tables 1983.

*Waist to hip girth ratio more than 1.

Cigarette Smoking

Smoking in this study was defined as current smoking and did not include ex-smokers. The prevalence of smoking in both sexes is shown in Table 12. Out of 209 men. 119 (56.9%) were smokers whereas only one female out of 42 gave the history of smoking. Majority of the male smokers (68.9%) gave history of smoking > 20 pack years (i.e. a pack of 20 cigarettes daily for more than 20 years).

Hypertension and Diabetes Mellitus

Total 21.5% patients gave history of hypertension (14.3% males, 57% females). But at the time of examination all had blood pressure

within normal limits. Prevalence of diabetes was the same in the whole group as that of hypertension (21.5%). Like hypertension it was more common in women (38%) as compared with men (18.2%). Of the total 251 cases 6.7% gave the history of simultaneous hypertension and diabetes mellitus. Results are shown in Table 13.

Table 12: Prevalence of cigarette smoking in men and women with IHD.

| | Total (n=251) | Men (n=209) | Women (n=42) |
|---------|------------------|----------------|-----------------|
| Number | 120 | 119# | 1 |
| Percent | 47.8 | 56.9 | 2.3 |

#Out of 119 male smokers 82 (68.9%) smoked > 20 pack year (i.e. a pack of 20 cigarettes daily for more than 20 years).

Table 13: History of hypertension and diabetes mellitus in cases of IHD.

| Exercise Level | Total (n=251) | | Men (n=209) | | Women (n=42) | |
|---------------------------------------|------------------|------|----------------|------|-----------------|------|
| | No. | % | No. | % | No. | % |
| Hypertension | 51 | 21.5 | 30 | 14.3 | 21 | 57 |
| Diabetes mellitus | 51 | 21.5 | 38 | 18.2 | 16 | 38.0 |
| Both Hypertension & diabetes mellitus | 17 | 6.7 | | | | |

Family History

Positive family history of IHD was defined as definite history of heart attack in the parents or siblings. A positive family history of IHD, hypertension and diabetes mellitus was noted in 30.6%, and 19.5% patients respectively (Table 14).

Table 14: Cases with family history of IHD, hypertension and diabetes mellitus.

| | Total number = 251 | |
|-------------------|--------------------|---------|
| | Number | Percent |
| IHD | 77 | 30.6 |
| Hypertension | 28 | 11.0 |
| Diabetes mellitus | 49 | 19.5 |

Lipid Characteristics

Total Serum Cholesterol

Figure 1 and Table 15 show percent distribution of patients according to total serum cholesterol. Figure 2 shows percent distribution of men and women in desirable, borderline and high risk category of total serum cholesterol. Seventy-four percent of the males and 42.9% of females had desirable serum total cholesterol. Higher percentage of females (57.1%) had total cholesterol > 200 mg/dl as compared with males (26%). Only 8% of the males had total cholesterol > 240 mg/dl, whereas 14.2% females had total cholesterol > 240 mg/dl. Mean serum cholesterol of the whole group was 182 ± 56 mg/dl. Range was 40 - 396 mg/dl.

Table 15: Total serum cholesterol, HDL-cholesterol, total cholesterol/HDL-ratio in males and females.

| Exercise Level | Total (n=251) | | Men (n=209) | | Women (n=42) | |
|-----------------------|------------------|------|----------------|------|-----------------|------|
| | No. | % | No. | % | No. | % |
| Total Cholesterol | | | | | | |
| > 200 | 173 | 68.9 | 155 | 74 | 18 | 42.9 |
| 200 - 239 | 56 | 22.3 | 38 | 18 | 18 | 42.9 |
| > 240 | 22 | 8.8 | 16 | 8 | 10 | 14.2 |
| HDL-C < 35 | 116 | 58.1 | 122 | 58.3 | 24 | 57.1 |
| Cholesterol/HDL-C > 5 | 150 | 59.7 | 125 | 59.8 | 25 | 59.5 |

HDL-C < 35 = High density lipoprotein cholesterol less than 35 mg/dl.

Total cholesterol/HDL-C > 5 = Ratio of total cholesterol to high density lipoprotein cholesterol more than 5.

Mean total cholesterol + SD = 182 + 56 mg/dl

Range = 40 - 396 mg/dl

Mean HDL cholesterol + SD = 35 + 14.5 mg/dl

Range = 12 - 133 mg/dl

LDL Cholesterol

As shown in Table 16 and Figure 3 like total cholesterol relatively low percentage of patients had high LDL-C. 33.5% of the total patients (n=251) had LDL-C > 130 mg/dl. 22.7% were in the borderline group (LDL-C 130-159 mg/dl). Only 10.8% were in the high risk group (LDL-C > 160 mg/dl). Results were not analyzed for both sexes separately.

HDL Cholesterol

In contrast to total cholesterol and LDL-C prevalence of low LDL-C (<35 mg/dl) was higher (58.1%) in the total group. Almost equal percentage of men and women had this characteristic (males :

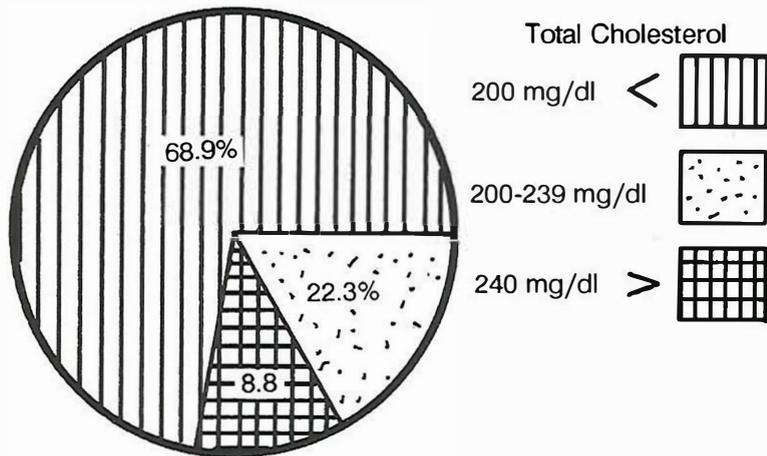


Fig. 1: Total cholesterol distribution in the whole group.

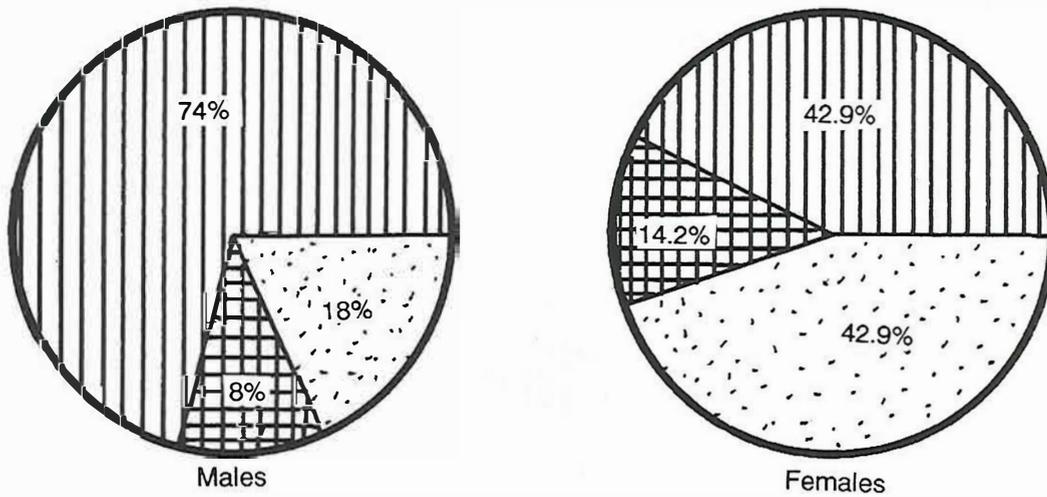


Fig. 2: Total cholesterol distribution in males and females.

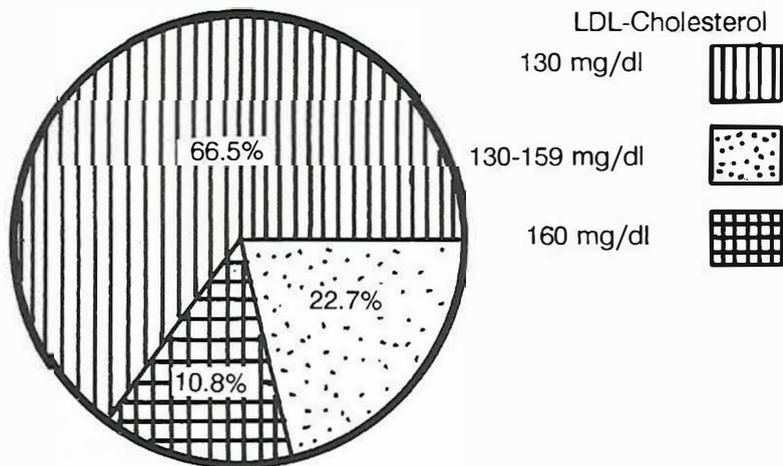


Fig. 3: LDL-cholesterol distribution in the whole group.

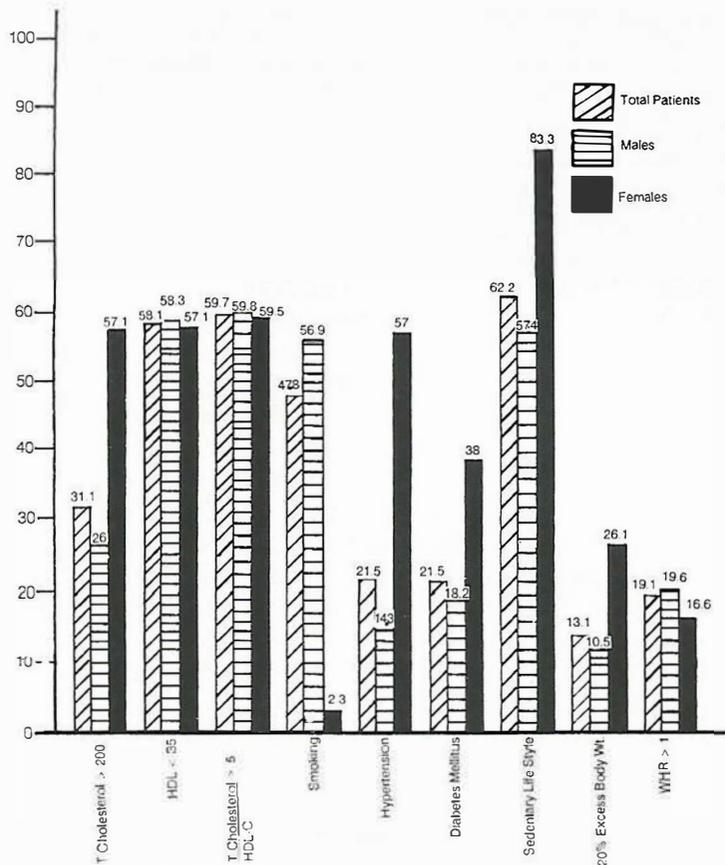


Fig. 4: Percent of total patient men and women with major risk factors.

58.3%, females : 57.1%) (Table 15). Mean HDL-C of the whole group was 35 ± 14.5 mg/dl.

Table 16: Distribution of LDL cholesterol in the whole group.

| LDL-C | Total number = 251 | |
|-----------|--------------------|---------|
| | Number | Percent |
| < 130 | 167 | 66.5 |
| 130 - 159 | 57 | 22.7 |
| > 160 | 27 | 10.8 |

LDL-C = Low density lipoprotein cholesterol.

Total Cholesterol/HDL Ratio

As shown in Table 15, 59.8% males and 59.5% females had total cholesterol/HDL ratio > 5.

Serum Triglyceride

Total 42 cases (16.7%) had serum triglycerides >200 mg/dl.

High Total Lipids

Total lipids > 1000 mg/dl were seen in 10 out of 251 cases (3.98%).

Serum Uric Acid

Ninety-three of the total 251 patients had serum uric acid > 7 mg/dl (37%).

Alcohol

A very small number of our patients gave the history of alcohol intake (3 out of 251 cases i.e. 1.19%).

Figure 4 shows percent of total IHD patients men and women with various risk factors.

IHD Without Risk Factors

Eleven percent of the 251 patients who had M.I. and unstable angina were free of the major risk factors i.e., smoking hypercholesterolemia, low HDL, hypertension, diabetes mellitus, obesity and family history. (Males : 11.9%; Females 3%).

DISCUSSION

Age and sex distribution of this study population is comparable with that reported in the world literature^{24,25}. Like in other countries in our study men had 5 times higher incidence of the disease than women and were younger.

The most dominant risk factors in both sexes were sedentary life style (62.2%), total cholesterol/HDL-C ratio > 5 (59.7%) and low HDL-C (58.1%). Sedentary life style has been shown to be a predisposing factor for atherosclerosis by observational, epidemiologic, post mortem and physiologic studies²⁶⁻²⁸. In experimental animals it has been proven that atherosclerosis is reversible/preventable with exercise²⁹. High prevalence of sedentary habits in our population suggests that leisure time physical activity should be emphasized in public health programmes.

Multivariate analysis has shown that independent of total cholesterol, 1 mg/dl increase in HDL-C is associated with 2 - 3 % decrease in the risk³⁰. Total cholesterol/HDL-C ratio is predictive of IHD risk for both sexes at all cholesterol levels even at total cholesterol value less than 200 mg/dl. Framingham analysis has shown that total cholesterol/HDL-C ratio of 5 is associated with the average risk. A ratio of 3.5 corresponds to half of the average risk, and ratios of 10 and 20 correspond approximately to 2-3 times the average risk respectively²³. High prevalence of low HDL-C and total cholesterol/HDL-C > 5 in our male and female patients compared with total cholesterol indicate that while estimating the risk status of an individual HDL-C should also be measured along with total cholesterol.

Only 26% of our study men had total cholesterol above 200 mg/dl. When this is compared with that reported in Pakistani men free of IHD (30.9%)³¹ high total cholesterol does not seem to be an important risk factor for our population.

Relatively high prevalence of hypertension (57%) and diabetes mellitus (38%) in female compared with the male patients are in keeping with the epidemiological data, which show that women sustaining AMI have high prevalence of hypertension and diabetes mellitus which are responsible along with increased age for poor prognosis in females³².

Percentage of male patients who were current smokers was 56.9%. This figure is significantly

higher than that reported in Pakistani men free of IHD (21%)³¹. High prevalence of smoking in IHD patients has also been reported from other third world countries³³. This study suggests that efforts to combat smoking in the society should be intensified.

In agreement with studies from Europe and U.S.^{34,35}, IHD in our study was prevalent in low social classes. This tendency was also observed in Multicentre Study² done in Pakistan. High prevalence of IHD seen in low socioeconomic class in this population is probably the result of diet (mainly banaspati ghee), increased smoking and stress.

A significant proportion of our patients had reported stressful life-style which is also implicated in the causation of IHD³⁶. However, the association between cardiovascular illness and psychological stress is not yet convincing. This is probably because of difficulty in defining and measuring complex variables as personality and stress³⁴⁻³⁸

Limitation of Study

This study is not controlled. Results would have been more reflective of the local risk pattern if age and sex matched controls were included in the study. Levels of serum lipids specially HDL-C decrease in the post infarction period but remain near normal if they are measured within 24-48 hours of admission³⁹. This study is done on post MI patients. Although we obtained the serum samples within 24-48 hours of admission but still high percentage of patients with low HDL-C and high total cholesterol/HDL-C ratio may be an over estimation. A large scale multicentre, age and sex matched, controlled study with multivariate analysis of risk factors should be conducted to establish the risk factors of IHD in Pakistan.

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