Epidemiology of Cardiovascular Disease in India

II. Ischemic Heart Disease

By S. Padmavati, M.R.C.P. (London), F.R.C.P. (Edin.)

India is fertile ground for the cardiovascular epidemiologist. With a population of 430 million and an area of 1,266,922 square miles, it offers great variety in ethnic groups and food habits. The population in the North is a mixture of the original Indo-Aryans with successive waves of invaders from the Northwest. That in the South is not quite so mixed, a large Dravidian element still being present. In addition, there are many so-called aboriginals with primitive ways of life. Food habits vary. The carbohydrate eaten may be rice, wheat, or millets. The common cooking oils and fats used in the different regions vary in their effect on the serum cholesterol levels. Thus coconut oil used in the Southwest and mustard oil used in Bengal have a cholesterol-raising effect, while sesame oil and safflower oil used in parts of the South and Central India have the opposite effect.

Although it is not our confirmed belief that the diet and its fat content are the only causes of coronary atherosclerosis, it would be proper to summarize here the data available at present on this aspect. Epidemiologic studies carried out over the past 5 years in four Indian cities* suggest these tentative conclusions: 1. The great majority of people (the low-income group) have a diet of low-fat content irrespective of the type of fat eaten (0 to 20 per cent of fat calories). 2. The well-to-do have a higher intake of fat calories (about 32 per cent) besides a better diet generally. 3. Serum cholesterol levels in three of the four cities studied were significantly higher in the rich than in the poor. In Delhi the serum cholesterol level could be correlated with the percentage of calories from fat.

In this paper the data available, although meager, have been critically reviewed.

Autopsy Data

At the present time routine medical autopsies are too few in the greater part of India for valid conclusions to be drawn. Recently in Delhi 200 hearts from medicolegal autopsies comprising both men and women were studied. These cases had all died from accidents or were sudden deaths. The ages ranged from 10 months to 104 years. A system of grading the degree of occlusive disease of the coronary arteries was employed, and atherosclerotic profiles were worked out for each decade for men and women separately. In figure 1 the data obtained have been compared with those of White et al. and Ackerman et al., who employed the same method of grading. It is obvious that

1. In Indian men the degree of atherosclerosis is much lower than in American men in every decade.

2. American women, on the other hand, resemble more closely Indian women.

3. In both sexes the disease makes its first appearance in the second decade (males, 15 years; females, 18 years) and increases steadily with age.

4. There were no cases with fresh thrombotic lesions and only two cases with old organized thrombi.

5. The peak period of the disease was the sixth decade in Indian men and the seventh

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*From the Department of Medicine, Lady Hardinge Medical College and Hospital, New Delhi, India.
**Incidence of atherosclerosis and hypertension in the various population groups of Delhi and their correlation with blood lipid studies** at the Lady Hardinge Medical College and Hospital, New Delhi.
***Study of environmental and nutritional factors affecting the incidence of atherosclerosis and coronary heart disease*** at the S. N. Medical College, Agra.
Nutrition Research Laboratories, Indian Council of Medical Research, Coonoor, South India. The work was done at Coonoor and Trivandrum.
in Indian women. There were very few cases, however, in the series after the seventh decade. The peak period in White's and Ackerman's series was the sixth decade for men and the eighth for women.

6. Severe degrees of sclerosis (grades 3 and 4) were rarer than in the American series. Thus White and Ackerman found 70 per cent and 60 per cent of severe sclerosis among men and women, respectively. In the present study the figures for men and women were 33 and 42 per cent.

7. The distribution of lesions in the three main branches of the coronary artery was in the same order in Indian and European men.

8. It would seem, therefore, from this small study that coronary artery disease although present in all Indians was milder in degree than in Europeans.

The incidence of thrombotic lesions also appears smaller. This study, extending over a larger series of cases, is being published separately.

Autopsy data from other parts of India are either very old or very sketchy. Thus in Bombay in 1941 Raghavan found, out of 4,335 autopsies, 568 cases or 13.1 per cent with cardiovascular lesions. The incidence of coronary artery disease in these 568 was 9.8 per cent (hypertension accounted for 11.9 per cent and rheumatic heart disease 29.3 per cent). The incidence of coronary artery disease was therefore 1.3 per cent in routine autopsies.

A review of the subject by Schroeder gave an incidence of coronary artery disease of 7.2 per cent in Bombay (9 out of 125 autopsies) and 21 per cent in Lucknow (21 out of 100 autopsies). These data must be treated with reserve in view of the small number of autopsies.

Life Insurance Statistics

The only medical insurance data available at the present time are from the Employees' State Insurance Scheme covering 1.6 million workers in 11 cities. Table 1 gives the prevalence rate in different Indian states in the years 1957-1958 and 1958-1959. The figures are constant for the 2 years from Delhi, Punjab, Uttar Pradesh, and West Bengal, but are very different in Bombay, Kerala, and Madras. Table 2 shows the comparison with figures from Britain, which are higher even among population groups least affected by the disease, such as postmen.

Hospital Statistics

The fallacies of deducing the incidence of heart disease in the general population from hospital statistics are obvious. The statistics available at the present time (all post war) for the incidence of coronary artery disease from hospital figures are given in table 3. As in the case of rheumatic heart disease it would perhaps be more correct to consider
coronary heart disease as a percentage of cardiac cases rather than as a percentage of over-all medical admissions. The latter vary from state to state due to the large number of infectious diseases. It is evident from table 3 that there is no great regional difference in the incidence, in spite of variation in climate.

Deaths due to heart disease in Delhi in a 5-year survey\textsuperscript{14} accounted for 7.7 per cent of all medical causes of death and 3 per cent of all causes of death. In western countries it is 50 per cent of all causes of death.\textsuperscript{15,16}

The incidence is variable, being highest in Amritsar and Calcutta. Some authors have stressed the difference in the incidence among the hospitalized and private patients,\textsuperscript{3,17,18} being higher in the latter. Among the private group Mathur et al.\textsuperscript{3} found an incidence of 32.5 per cent as against 7.0 per cent in the hospital cases. Banerjea\textsuperscript{18} found that 73.9 per cent of his patients belonged to the higher income group, being professional and businessmen. Compared to other countries it will be noted that the general incidence in India is lower even than in relatively underdeveloped countries like Mexico\textsuperscript{19} and the Philippines.\textsuperscript{20} The figures from Western countries are considerably higher (table 4).

The percentage of coronary artery disease in relation to total medical admissions in Delhi in a 5-year survey for persons over 40 years was 0.2 per cent. This figure is the lowest for any country in the world as far as available statistics indicate (table 5).

The ratio of men to women in Delhi, Agra, Bombay, and Calcutta was 7:1, 9.8:1, 4.5:1, and 14:1, respectively. This disparity may not be quite true, as many more women than men seek admission into hospitals in India.

The peak period of the incidence of coronary heart disease is shown in table 6. It is obvious that in all Indian states from which such data are available it is at least a decade earlier (two decades in the case of Bombay\textsuperscript{21,22}) than in the U.S.A.\textsuperscript{16,23} (table 6).

Relative Incidence of Cerebrovascular and Ischemic Heart Disease

In a recent 6-year survey (1954 to 1959)\textsuperscript{24} from two large general hospitals in Delhi 276 cases of ischemic heart disease and 334 cases of degenerative cerebrovascular disease were encountered among 29,160 medical admissions. The incidence of ischemic heart disease is 0.3 per cent of total admissions and 0.7 per cent of medical admissions. The incidence of cerebrovascular disease is 0.44 per cent and 1.1 per cent of total and medical admissions, respectively.

There is thus a higher incidence of both types of vascular disease among men than in women, and a higher incidence of cerebrovascular disease as compared to ischemic heart disease in both sexes. The ratio of cerebrovascular disease between men and women was 1.2:1 and of ischemic heart disease 2.2:1.

The peak period for the incidence of cerebrovascular disease was the seventh decade in men and the sixth in women.

The types of ischemic heart disease were different in the two sexes. Myocardial infarction was 6.5 times as common in men as in women. The types of ischemic heart disease encountered in women were congestive cardiac failure, electrocardiographic changes (usually symptomless), myocardial infarction, and

\begin{table}
\centering
\caption{Incidence of Coronary Artery Disease from Life-Insurance Statistics (per 1,000 Population)}
\begin{tabular}{lll}
\hline
India & Employees State Insurance Corporation & 1957-58\textsuperscript{11} \\
 & & Average 0.49 \\
 & & (Range 0 to 0.97). \\
United Kingdom & Morris et al.\textsuperscript{20,26} \\
 & Age 40 & 1958-59\textsuperscript{3} \\
 & & Average 0.63 \\
 & & General practitioners, 7.1 \\
 & & Other doctors, 3.3 \\
 & & Miscellaneous nonmedical, 2.5 \\
 & & Postmen (age 35-59), 1.8 \\
\hline
\end{tabular}
\end{table}
Table 3
Incidence of Coronary Artery Disease in India (Percentage of Cardiac Cases)

<table>
<thead>
<tr>
<th>Area, year and reference no.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi, 1951-55</td>
<td>11.8</td>
</tr>
<tr>
<td>Bombay, 1949</td>
<td>13.5</td>
</tr>
<tr>
<td>Bombay, 1956</td>
<td>12.1</td>
</tr>
<tr>
<td>Calcutta, 1956</td>
<td>17.3</td>
</tr>
<tr>
<td>Amritsar, 1953</td>
<td>21.6</td>
</tr>
<tr>
<td>Madras, 1946</td>
<td>13</td>
</tr>
<tr>
<td>Lucknow, 1953</td>
<td>10.2</td>
</tr>
<tr>
<td>Agra, 1958</td>
<td>7</td>
</tr>
<tr>
<td>Himachal Pradesh, 1956-57</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 4
Comparison of Incidence of Coronary Artery Disease in India and Foreign Countries (Percentage of Cardiac Cases)

<table>
<thead>
<tr>
<th>Area, year and reference no.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico, 1942</td>
<td>17.6</td>
</tr>
<tr>
<td>Philippines</td>
<td>14.8</td>
</tr>
<tr>
<td>New England, 1953</td>
<td>48.5</td>
</tr>
<tr>
<td>Argentina, 1943</td>
<td>29.6</td>
</tr>
<tr>
<td>Hawaii, 1949</td>
<td>33</td>
</tr>
<tr>
<td>Puerto Rico, 1945</td>
<td>39.7</td>
</tr>
<tr>
<td>India</td>
<td>6.21</td>
</tr>
</tbody>
</table>

Table 5
Ratio of Coronary Artery Disease to Total Medical Admissions (Percentage) Over 40 Years

<table>
<thead>
<tr>
<th>Country and reference no.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>1.7</td>
</tr>
<tr>
<td>Delhi</td>
<td>0.2</td>
</tr>
<tr>
<td>Italy</td>
<td>1.7</td>
</tr>
<tr>
<td>Naples</td>
<td>3.3</td>
</tr>
<tr>
<td>Bologna</td>
<td>1.3</td>
</tr>
<tr>
<td>Sweden</td>
<td>14</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>18.2</td>
</tr>
<tr>
<td>Boston</td>
<td>26.2</td>
</tr>
<tr>
<td>Twin Cities</td>
<td></td>
</tr>
</tbody>
</table>

angina pectoris, in that order; whereas in men it was myocardial infarction, angina pectoris, electrocardiographic changes (symptomless), and congestive heart failure.

Cerebral thrombosis followed by cerebral hemorrhage was the commonest type of cerebrovascular disease encountered in both sexes. In women, a large number of patients during the childbearing period (20 per cent) had cerebral thrombophlebitis usually associated with pregnancy or the puerperium.

Hypertension was an important etiologic factor in the genesis of both cerebrovascular (thrombosis and hemorrhage) and ischemic heart disease. Thus 22 per cent of the cases of ischemic heart disease and 31.7 per cent of cases of myocardial infarction were hypertensive; 42.0 per cent of the cases of cerebral thrombosis were also hypertensive. When the cases of hypertension were excluded from the study there was a preponderance of cases of ischemic heart disease over those of cerebral thrombosis. There were only 215 cases of ischemic heart disease (140 men and 75 women) as against 151 cases of degenerative cerebrovascular disease (100 men and 51 women) giving an over-all ratio of ischemic heart disease to cerebrovascular disease of 1.4:1, a figure that was also true for both sexes considered separately.

It seems therefore, that without hypertension ischemic heart disease was commoner than cerebrovascular disease in both sexes. Hypertension was a more potent cause of both types of vascular diseases in women than in men.

Of the 171 cases whose occupations were definitely known, there were 61 in the professional group, 38 in the clerical group, 36 from laboring classes, and 36 housewives, the professional classes thus outnumbering all other occupational groups.

Epidemiologic Surveys

The data available at the present time are from three centers where epidemiologic studies have been in progress during the past 2 to 5 years. In these surveys the prevalence of coronary heart disease has been studied in random samples of different population groups. The criteria for the diagnosis of coronary artery disease have been described elsewhere. An exercise test has been used where the resting electrocardiogram was normal. The data are summarized in table 7. It would appear that

1. From the three independent surveys the
Table 6
Peak Period of Incidence of Coronary Artery Disease

<table>
<thead>
<tr>
<th>Area and reference no.</th>
<th>Age (yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bombay</td>
<td>40-49</td>
</tr>
<tr>
<td>Vakil</td>
<td>41-50</td>
</tr>
<tr>
<td>Samani</td>
<td>50-59</td>
</tr>
<tr>
<td>Amritsar</td>
<td>51-60</td>
</tr>
<tr>
<td>Calcutta</td>
<td>51-60</td>
</tr>
<tr>
<td>Delhi</td>
<td>60-70</td>
</tr>
<tr>
<td>Agra</td>
<td></td>
</tr>
<tr>
<td>U.S.A.</td>
<td></td>
</tr>
<tr>
<td>White (1943)</td>
<td>51-60</td>
</tr>
<tr>
<td>White (1951)</td>
<td>60-70</td>
</tr>
</tbody>
</table>

Table 7
Incidence of Coronary Artery Disease in General Population in India (Epidemiologic surveys)

<table>
<thead>
<tr>
<th></th>
<th>Delhi*</th>
<th>Agra*</th>
<th>Coonoor*</th>
<th>Trivandrum*</th>
</tr>
</thead>
<tbody>
<tr>
<td>High income</td>
<td>6.52%</td>
<td>6.6%</td>
<td>6.52%</td>
<td>6.52%</td>
</tr>
<tr>
<td></td>
<td>(1426)</td>
<td>(316)</td>
<td>(106)</td>
<td>(138)</td>
</tr>
<tr>
<td>Low income</td>
<td>6.4%</td>
<td>1%</td>
<td>0%</td>
<td>6.4%</td>
</tr>
<tr>
<td></td>
<td>(1426)</td>
<td>(573)</td>
<td>(241)</td>
<td>(145)</td>
</tr>
</tbody>
</table>

*Reference number.
†Figures in parentheses represent total number examined in each group.

Discussion

The prevalence of coronary artery disease in India appears to be low. The limitations of autopsy data have already been pointed out but from the study of the small group at Delhi it would seem that the general incidence of major sclerosis and actual thrombosis is less than in the West. Hospital statistics also show a lower incidence than in other countries.

The incidence of the disease is higher in the high-income groups than in the low. In both clinical and epidemiologic studies at Delhi the professional and managerial classes outnumbered the others. Cerebrovascular disease appears to be slightly more common than ischemic heart disease in men and twice as common in women. This is the reverse of what is found in the United Kingdom and America, where there is more ischemic than cerebrovascular disease. According to Schroeder the incidence of cerebrovascular and ischemic heart disease is variable in different parts of the world.

Among the factors that may be responsible for the difference in the high- and low-income groups may be: 1. the longer expectation of life among the upper classes. 2. A richer diet with 32 per cent fat calories among high-income groups as opposed to 17 per cent among the poor. The type of fat eaten does not seem to apply in view of the low-fat intake in this group. The serum cholesterol levels of high-income groups are also higher than those of low-income groups as stated earlier. Whether diet is the only factor in the etiology of coronary artery disease is a difficult point to decide. Even in the
Table 8
Incidence of Coronary Artery Disease in Population Surveys Outside India (Percentage)

<table>
<thead>
<tr>
<th>Country</th>
<th>Authors and reference no.</th>
<th>Occupation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A.</td>
<td>Epstein(^{28})</td>
<td>Garment Workers—</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Italian</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jews</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other ethnic</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Philips et al.(^{42})</td>
<td>Civil servants</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Weinerman et al.(^{42})</td>
<td>Longshoremen</td>
<td>3.6</td>
</tr>
<tr>
<td>U.K.</td>
<td>Thomas et al.(^{27})</td>
<td>Miners-Welsh</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Aged 55-64)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Morris et al.(^{28})</td>
<td>Medical practitioners</td>
<td>23.5</td>
</tr>
</tbody>
</table>

high-income groups, the incidence of coronary artery disease is much less than in the United Kingdom\(^{29}\) and the U.S.A.\(^{30}\) as judged from clinical and autopsy figures, despite a comparable fat intake. 3. The unmeasurable factor of mental stress and strain, which might be more evident among the upper classes.

The remarks regarding age incidence of vascular diseases must be treated with reserve, as the great majority of patients of the hospital class in India are ignorant of their dates of birth. Muir\(^{30}\) stated that in Singapore the age incidence in oriental communities was at an earlier age than in the West. Most of his patients with coronary artery disease died before attaining the age of 55 years.

As 90 per cent or more of the population of India is composed of low-income groups, the generalization about the low incidence would seem to apply to the great mass of people. This may not apply to all Indians. Thus Muir\(^{30}\) reported a high incidence among Indians and a low incidence among Chinese in Singapore. The same observations were made by Danaraj et al.\(^{31}\) Nutritional standards of Indians in Singapore are higher than those of Indians in India, other factors may be operative.

Summary and Conclusions

The prevalence of coronary artery disease in India has been assessed in the different states from the available autopsy, clinical, life insurance, and epidemiologic data.

Autopsy data from Delhi suggest infrequent occurrence at all ages of severe grades of sclerosis and of thrombotic lesions.

Clinical figures indicate a higher incidence of cerebrovascular disease than ischemic heart disease in both sexes, the disparity being more marked in women. Hypertension was an important cause in both the diseases.

They also show a relatively low incidence of ischemic heart disease as compared to other types of heart disease. The types of ischemic heart disease were different in the two sexes. The disease was also more prevalent among the well-to-do.

Life insurance data although limited to industrial workers suggests a low incidence as compared to other countries.

Epidemiologic studies show a higher incidence in high-income groups and a much lower incidence in the low-income groups as compared to other countries.

The significance of these data are discussed.

References

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S. PADMAVATI

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