Effects of Hereditary and Environmental Factors on Development of Myocardial Infarction

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IT HAS been shown that several hereditary and environmental factors have influences on the development of myocardial infarction, in familial studies, studies on different occupational groups and also in investigations focusing on dietary factors.¹⁻⁵

It is very difficult, however, to evaluate which factors are more important, hereditary or environmental factors, because there is a great deal of complexity about the interrelationship between these factors.

The present study was carried out to analyse the hereditary and environmental factors in the development of myocardial infarction in our country, and discuss the preventive measure of myocardial infarction.

MATERIALS AND METHODS

Five hundred and thirty patients who had visited Nagoya University Hospital and several hospitals in Aichi, Mie and Gifu prefectures in the past thirteen years (1958 to 1971) with acute myocardial infarction and sex age-matched series of 530 cases who looked healthy and had no severe E C G abnormality were selected for this survey.

The male to female ratio 4.8 to 1. The patients and controls were interviewed and epidemiological data on the predisease state were obtained.

For the years 1958-1971, the meteorological data of weather, maximum, minimum, and

average temperature, barometric pressure, humidity and passage of front were obtained from the data in the Nagoya Meteorological Observatory.

RESULTS

I. Hereditary factors

There was a very high family incidence of cardiovascular disease (hypertension, apoplexy, ischemic heart disease and sudden death etc.) among the patients—72% of them having one or more affected parents or sibling in contrast to 46% the controls. (Fig. 1) The relative risk of the persons with one or more of such family history was 2.93 times higher incidence rate than those with nothing of them.

There were significant difference between the MI-Group and controls in the case of both parents affected with hypertension, or either parents or sibling or more affected with apoplexy (Fig. 2)

II. Coronary risk factors

For clarity of visualization the main predisposing factors in the development of myocardial infarction have been presented in cumulative frequency diagrams. (Fig. 1)

The incidence of hypertension (150 mmHg. or greater), hypercholesteremia (225 mg/100 ml or greater), diabetes mellitus, heavy smoking (twenty or more cigarettes a day) and family history of cardiovascular disease in the cases of myocardial infarction were significantly higher than that in the control group. No significant relationship was found between overweight and incidence rate of myocardial infarction.

As shown in Fig. 3, the persons with a couple of (1) hypercholesteremia and family history had the highest relative risk. The persons with such a couple had 9.38 times higher than those without

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Fig.1. Cumulative frequency distribution of coronary risk factors in the myocardial infarction and the control group.

— Myocardial infarction

--- Control

*** $P < 0.001$

** $P < 0.01$

* $P < 0.05$

such a pair of hypercholesteremia and family history.

Similarly, the relative risk of the persons with a couple of risk factors such as (2) hypercholesteremia and hypertension, (3) hypercholesteremia and heavy smoking, (4) hypercholesteremia and diabetes mellitus, and (5) hypercholesteremia and obesity were 7.95, 7.20, 6.71 and 5.35 times higher respectively than those without such a couple of risk factors.

III. Environmental Factors

1. Working condition and occupational class

Table 1. showed the working conditions and occupational classification of the patients. The expected number of cases (E) were calculated from the reports of the Japan census. As indicated in Table 1. (a), the distribution of the

working conditions in 505 patients showed brain workers in 52.3 per cent (264 Cases) before the onset of the disease, while in the cases expected (E) 38.7 per cent (196.3 Cases) were brain workers. This difference was significant statistically.

As shown Table 1. (b), 9.17 per cent (48 cases) of the patients were classified as professional, 15.5 per cent (82 cases) managerial, and 20.2 (106 cases) per cent clerical occupation, and 16.6 per cent (87 cases) in skilled labor. When comparison is made between the number of the expected and observed, it is apparent that there is a significantly increased risk of myocardial infarction in persons classified professional, managerial and clerical occupations. The managerial persons had a incidence rate 9.96 times higher

Fig. 2. Comparative incidence of hypertension, diabetes mellitus, ischemic heart disease, apoplexy, cancer and sudden death between the myocardial infarction group and control group.

than those classified the other occupations. (Table 1).

2. Dietary habits

We noted that the dietary habits of excessive intake in total fats, sugar, and salt were correlated significantly to the development of myocardial infarction. On the contrary, the habits of excessive intake in total calories did not have any effects on the incidence of myocardial infarction.

There was no significant difference in incidence of alcohol drinkers between these two groups.

3. Meteorological phenomena

The relation between meteorological phenomena and the incidence of acute myocardial infarction shown in Table 2. As indicated in Table 2, there was a significantly increased incidence of acute myocardial infarction on snowy day, cold weather (temperature of 5°C or lower) and sudden changes in temperature (max. temp. - min. temp. > 10°C).

The meteorological phenomena of barometric pressure, humidity and passage of front, however, did not have significant effects on the incidence of acute myocardial infarction.

4. Seasonal and monthly incidence

During the winter months (December, January, February) 214 attacks (31%) occurred; 172 (25%) occurred in the autumn (September, October, November); 159 (23%) occurred in spring (March, April, May); and 145 (21%) occurred in summer (June, July, August). The highest monthly incidence was December (82 Cases) and the lowest was August (44 Cases).

The difference in seasonal incidence were not statistically significant and became less and less in comparison with our previous report⁷.

5. Attack times

During 6 p.m.-12 p.m. 122 attacks (32%) occurred; 95 (24.9%) occurred during 6 a.m.-12 a.m.; 90 (23.5%) occurred 0 p.m.-6 p.m.; and 75 (19.4%) occurred during 0 a.m.-6 a.m. The highest incidence was during 6 p.m.-12 p.m. (32%) contrarily the lowest incidence was 0 a.m.-6 a.m. (Fig. 5).

6. Activity immediately preceding attack

Patients activities immediately preceding an attack of acute myocardial infarction in 350 cases, we noted physical exercise in only 19.7 per cent, whereas in 26.0 per cent of the cases the patients was asleep. In 7.7 per cent had occurred during or after eating, in 6.9 per cent during

Fig.3. Combinations of risk factors relative risk.

TABLE I OCCUPATIONAL DISTRIBUTION IN MYOCARDIAL INFARCTION CASES
(a) Working condition

Working condition	Cases obs. (O)	Cases exp. (E)	$[(O-E)/E] \times 100$
Physical work	102	144.3	-29.3**
Brain work	264	196.3	+34.5***
Intermediate	139	164.4	-15.5
Total	505	505.0	

(b) Occupational class

Occupation	(O)	(E)	$[(O-E)/E] \times 100$
Professional	48	26.7	+79.8*
Managerial	82	19.1	+329.3***
Clerical	106	65.5	+61.8***
Selling	51	56.7	-10.1
Agricultural, forestry, & fishery	57	46.3	+23.1
Skilled, productive	87	193.0	-54.9***
Service	14	34.1	-58.9
The other	16	19.6	-18.4
Total	461	461.0	

** $p < 0.01$ *** $p < 0.001$

TABLE II ATTACKS OF MYOCARDIAL INFARCTION AND METEOROLOGICAL CONDITION

(a) Weather			
Weather	Cases obs. (O)	Cases exp. (E)	$[(O-E)/E] \times 100$
Fine & clear	49	55.4	-11.6
Clear	113	108.5	+ 4.2
Claudy	49	53.8	- 8.9
Light rain	24	27.6	-13.0
Rain	52	53.9	- 3.5
Snow	15	2.8	+435.7***
Total	302	302	
(b) Air temperature			
Temperature (°C)	(O)	(E)	$[(O-E)/E] \times 100$
— 0	6	1.0	+500.0***
0 —	63	48.0	+31.5
5 —	65	45.5	+42.9
10 —	46	44.1	+ 4.3
15 —	35	49.8	-29.7
20 —	39	54.7	-36.0
25 —	32	43.9	-27.1
30 —	2	1.0	+100.0
Total	288	288	
(c) Max. Temp. — Min. Temp.			
Max. Temp. — Min. Temp. (°C)	(O)	(E)	$[(O-E)/E] \times 100$
— 5	24	34.1	-29.6
5 —	113	133.7	-15.5
10 —	137	106.8	+28.3*
15 —	14	13.4	+ 4.5
Total	288	288	

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.1$

walking, 6.9 per cent during conference or interview, and in 6.6 per cent after drinking.

DISCUSSION

Our understanding of the genesis of myocardial infarction is still inadequate, myocardial

infarction is at present regarded as a disease of multifactorial etiologies, in which (1) hypercholesteremia, (2) hypertension (4) diabetes mellitus, (5) heavy smoking and (6) heredity etc. are considered important predisposing factors!^{1,2,6}

Fig.4. Seasonal incidences of myocardial infarction

Fig.5. Attack times of myocardial infarction

Fig.6. Schematic representation of the complexity of the hereditary and environmental influences on development of myocardial infarction.

The greater part of these factors, were confirmed on the basis of the data collected in present prospective epidemiological studies in the United States^{2,3,6,8}

Our observations clearly demonstrate that the predisposing factors in the developments of myocardial infarction in present-day Japan have a strong resemblance to those in Western countries.

The incidence of hypertension (systolic pressure of 150 mmHg. or greater), hypercholesteremia (225 mg/100 ml or grater), diabetes mellitus, heavy smoking (twenty or more cigarettes a day) and family history of cardiovascular disease in the cases of myocardial infarction were significantly higher than that in the control group. In a previous communications⁷ however, it was shown that the frequency distribution of coronary risk factors between the patients with myocardial infarction and the patients with ischemic heart diseases other than myocardial infarction did not difference significantly both in quality and in quantity.

Consequently, in the development of myocardial infarction the short-acting factors that have a more direct effect must play a important role in addition to the long-acting factors such as heredity and the coronary risk factors. From the

present study it would appear that heredity and diat habits and occupational effect are important mainly as the long-acting factors, and meteorological phenomena (snowy day, cold weather and sudden change of air temperature) and immediate occasion (extremely hard work, insufficient sleep, stress, cold, drinking, and over-eating etc.) are as short-acting factors, Fig. 6 shows shematic representation of the complexity of the long-acting and short-acting factors which may influence on the development of myocardial infarction.

In the Framingham study⁸, the men with any one of the abnormal — hypercholesteremia, hypertension and cigarette smoking — had a ten year C H D incidence rate 1.9 times higher than those with no abnormalities, men with any two abnormal had a 3.5 times higher rate and men with all three abnormalities had a 10.6 times higher rate. In our study, combinations of two factors — (1) heredity and hypercholesteremia, (2) hypertension and hypercholesteremia, (3) cigarette smoking and hypercholestermia (4) diabetes mellitus and hypercholesteremia — revealed a marked range of risk.

We cannot control our heredity, but other five risk factors can be controled and corrected by chiefly nutritional and medical treatments.

We would like to emphasize that the early discovery of such risk factors is very important to prevent myocardial infarction, and all possible preventive measures should be employed when such a combination of risk factors as stated above are present.

SUMMARY

To study hereditary and environmental factors on the development of myocardial infarction, five hundred and thirty men and women with myocardial infarction were compared with an age and sex-matched series of 530 healthy subjects.

1. A much greater incidence of myocardial infarction was noted when one or more among parents and sibling had a history of hypertension, apoplexy, ischemic heart disease or sudden death than when neither parents nor sibling suffered from these disease.

2. Combinations of two factors — (1) heredity and hypercholesteremia, (2) hypertension and hypercholesteremia, (3) cigarette smoking and hypercholesteremia, (4) diabetes mellitus and hypercholesteremia revealed a marked range of risk.

3. The persons classified in managerial, professional and clerical occupation had a much higher incidence rate than those in the other occupations.

4. The dietary habits of excessive intake in total fats, sugar, and salt were correlated significantly to the development of acute myocardial infarction.

5. There was a significantly increased incidence of acute myocardial infarction on snowy day, cold weather and sudden changes in temperature.

6. The highest monthly incidence was December and the lowest was August. The seasonal difference became less and less.

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