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Incidence of Cerebral Apoplexy on an Isolated Island in Shimane Prefecture

(mortality rate/diet/cerebral apoplexy)

MANABU TADA[a], ROHSUKE KAMEIYE[b], MAKIKO SAKURA[b], REIKO FUJINAGA[b], KIYONORI SHIRAISHI[b], and RYOTARO SEKI[b]

[a]*Department of Environmental Medicine, Shimane Medical University, Izumo 693 and* [b]*Shimane Saigo Health Center, Saigo 685, Japan*

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The mortality rate from cerebral apoplexy on this isolated island is lower than that in Shimane Prefecture and also the nationwide average. The incidence of death due to cerebral apoplexy is low in the elderly but high in middle aged persons.

The mean blood pressure level and the incidence of the hypertension are low compared with findings in Shimane Prefecture and the nationwide average and the incidence of abnormal ECG is also low.

In younger persons, cerebral apoplexy usually develops, therefore, related processes in this disease appear to be related to physical labor, stress and fatigue. In the elderly, the occurrence often develops during the cold weather.

Ingestion of lipids and animal proteins has increased considerably compared with other elements. There is a marked yearly increase in the intake of milk and dairy products followed by eggs, seafood and meat. Thus the low death rate from cerebral apoplexy is probably diet related.

On an isolated island located 70 km north of Shimane Peninsula in the Japan Sea there are a town and three villages, the total population of which was 19,680 in 1975.

Persons aged 65 years and over account for 15.2%. On the island live many farmers who work the land and fish, in about equal ratios. Human relations peculiar to local communities are quite evident.

Medical facilities include 12 clinics and one hospital, but many of the physicians are no longer young and there are only 3–4 full-time physicians at the hospital. Such being the situation, the health care activities at ordinary times may be mentioned as one of the important props in the management of health.

We analyzed and evaluated the present situation mainly with reference to death following cerebral apoplexy. We report herein the results of the

Abbreviations used : SP, Shimane Prefecture ; SHC, Saigo Health Center ; TV, Tsuma Village ; GV, Goka Village ; FV, Fuse Village ; ST, Saigo Town.

analysis and evaluations.

MATERIALS AND METHODS

This island with a population of 19, 680 and an area of 244 km^2 in the Japan Sea about 70 km north of the eastern tip of Shimane Prefecture (SP) is comprised of one town and three villages. The population is 14,573 in the town Saigo (ST), 672 in the village Fuse (FV), 2,073 in the village Goka (GV) and 2,362 in the village Tsuma (TV). These towns and villages are within the jurisdiction of the health center, Saigo (SHC).

As for the death certificates and Shimane Prefecture health statistical books, those available from 1968 to 1978 were used. Data on the health examination used were those obtained in the examinations conducted at SHC from 1955. Height and body weight were measured, and relative body weight was computed using the chart of Minowa *et al.* (1).

Blood pressures were taken with all persons in the sitting position after at least 15 minutes rest. The definition of hypertension is that of WHO : systolic blood pressure levels of 160 mmHg or over and/or diastolic blood pressure levels of 95 mmHg or over.

Resting ECG was taken in 2,600 persons and the Minnesota code (2) was used in classification of the findings.

Data on nutrition were those obtained in a survey on nutrition conducted 11 times at SHC from 1951 to 1977 and also in a survey by interview which was carried out in 1978 and 1979.

Based on these data, tabulation and analysis were made.

RESULTS

1. Mortality Rate from Cerebral Apoplexy

Mortality Rate from Cerebral Apoplexy for All Age Groups

Deaths due to cerebral apoplexy were grouped into two, namely, those occurring from 1968 to 1972 and others occurring from 1973 to 1977. The gross mortality rate from cerebral apoplexy (for a population of 1,000) was 2.42 for men and 1.85 for women on the average for 1968 to 1972 and 2.42 for men and 1.79 for women on the average for 1973 to 1977 at SHC.

Because of the advanced ages of the persons among the population, a comparison on the basis of the corrected mortality rate is shown (Fig. 1).

When a comparison was made between towns, villages and Shimane Prefecture, the mortality rate was low, except in the case of men of FV and GV where the rates were high. When SHC was compared with SP, SHC showed a low rate in both men and women.

Mortality Rate from Cerebral Apoplexy among the Middle-aged (40—69 Years of Age)

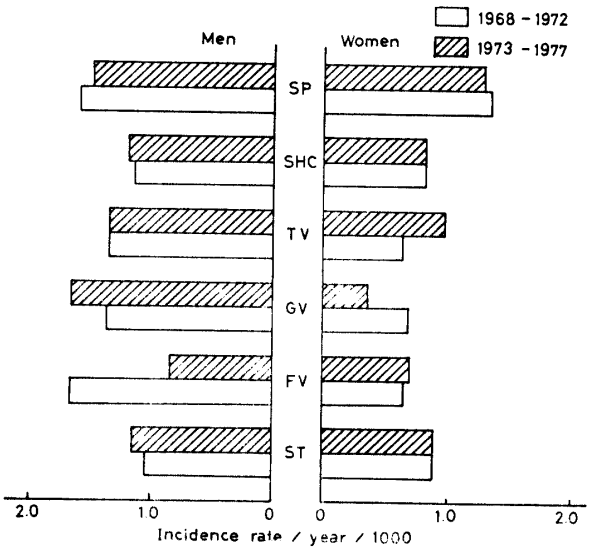

Fig. 1. Age-adjusted mortality rate from cerebral apoplexy by town and village.

When compared with SP regarding the mortality rate from cerebral apoplexy those aged 40 to 69 years, the rate was low in both men and women for 1968 to 1972 and 1973 to 1977 (Fig. 2). The mortality rate tended to

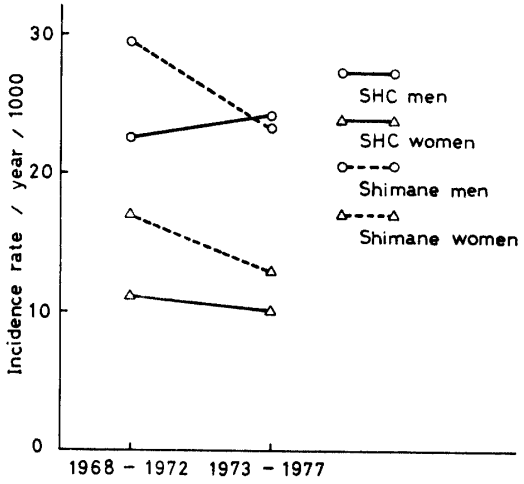

Fig. 2. Mortality rate from cerebral apoplexy among middle aged (40—69 years of age).

increase in men of SHC, while in the other areas there was a tendency toward decrease.

2. Period from Onset of Cerebral Apoplexy to Death, and Attempt to Estimate the Month at Onset

Period from Onset

The period from onset of the disease to death was categorized as : within

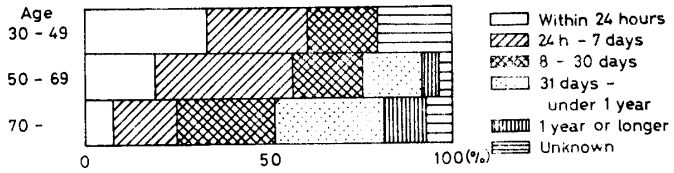

Fig. 3. Period from onset of cerebral apoplexy to death.

24 hours, 1—7 days, 8—30 days and over 30 days, on the basis of the available death certificates. The results are as shown in Fig. 3. In the 30—49 age group, many patients died within one month, while deaths within 24 hours accounted for 33 percent, 1—7 days for 38 percent and 8—30 days for 19 percent.

In the 50—69 age group, the period from onset of the disease to death was somewhat longer and accounted for 19 percent. Deaths during 1—7 days accounted for 38 percent and deaths one month or longer included 20 percent.

These findings were more conspicuous in the elderly and the major attacks seems to occur in the young and the minor attacks in the persons of advanced age.

The time from the occurrence of apoplexy to death was longer in the elderly persons, thus implying an increase in the number of bedridden persons.

Month at Onset

Fig. 4 shows the period from the onset of cerebral apoplexy to death, as based on data in the death certificates.

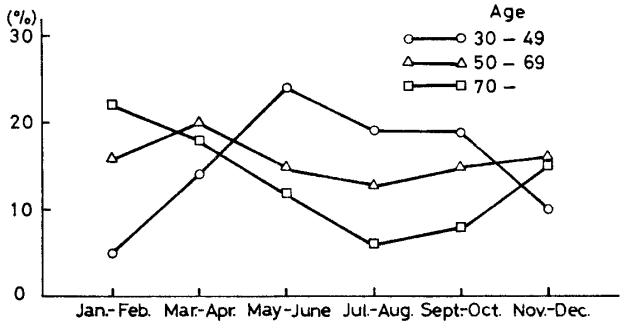

Fig. 4. Month at onset of cerebral apoplexy.

Percentage-wise, the results are broken down to Nov.-Feb. 15%, Mar.-June 30% and July-Oct. 38% in the 30—49 age group and Nov.-Feb. 38%, Mar.-June 30% and July-Oct. 15% in the 70-or-over age bracket.

In persons aged 30—49 years, this disease often developed at a time when they were engaged in outdoor work, implying that the development was related to physical labor and stress. In elderly persons, cerebral apoplexy more often occurred when it was cold. Therefore, a relationship between temperature and the occurrence of apoplexy would have to be considered.

3. Mass Examination

Early appropriate treatment and health guidance after early detection at the time of mass examination are considered to be measures of prevention.

Medical Examination

The so-called primary examination includes history taking, measurement of the blood pressure, urinanalysis, medical examination and health guidance, as conducted by SHC all over the island since 1955.

A secondary examination has been conducted for new applicants and those showing abnormal findings in the previous examination since 1961 (Table I).

TABLE I. *Number of Subjects and Two-Stage Examination for Hypertension*

Year	No. of subjects	Primary examination No. of persons examined (%)	Secondary examination No. of persons examined (%)	No. of persons requiring medical treatment (%)
1970	9,106	3,268 (35.9)	2,018 (61.7)	575 (17.6)
1971		2,309 (36.3)	1,502 (45.4)	502 (15.1)
1972		1,896 (20.8)	1,670 (88.1)	317 (16.7)
1973		2,663 (29.2)	948 (35.8)	254 (9.5)
1974		3,255 (35.7)	1,392 (42.8)	389 (12.0)
1975	9,636	3,655 (37.9)	2,340 (64.0)	440 (12.0)
1976		2,092 (21.7)	937 (44.8)	210 (10.0)
1977		3,496 (36.3)	1,586 (45.4)	261 (7.5)
1978		3,860 (40.4)	1,998 (51.8)	374 (9.7)

The primary examination was taken by 20 percent of a small number of applicants and by 40 percent among those with many applicants. The percentage of persons requiring early treatment as a result of the medical examination decreased gradually with 18% in 1970, 12% in 1975 and 10% in 1978.

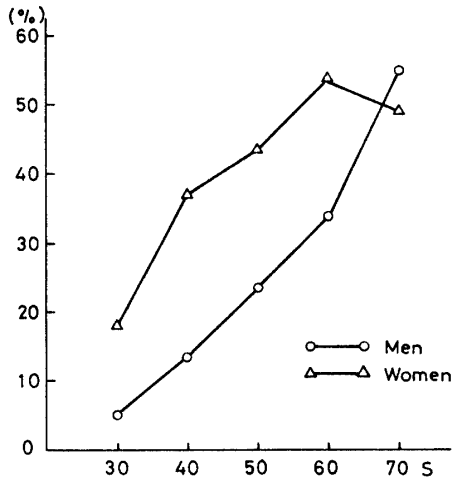

Fig. 5. Medical examinations according to age (1978).

While there was a fixed number of regular applicants, those not undergoing a medical examination continually tended to increase in number.

Regarding the medical examination taken in 1978, the rate was higher in women and in the case of elderly persons was high in both men and women (Fig. 5).

Blood Pressure

The relationship between cerebral apoplexy and hypertension is still the topic of various discussions (3—5).

In 1978, the levels were higher in men in all age groups except in those in their 80s (Table II). The blood pressure level for those within the

TABLE II. *Means and Standard Deviations of Systolic and Diastolic Blood Pressures*

Sex	Age	No. of persons examined	Systolic pressure ± SD	Diastolic pressure ± SD	No. of the hypertensives (%)	Percentage of hypertensives among all Japanese
			mmHg	mmHg		
Men	30—39	28	134±20	80±13	7(25.0)	10.4
	40—49	136	133±21	82±15	23(16.9)	19.2
	50—59	224	134±23	83±14	52(23.2)	30.3
	60—69	229	146±25	85±13	72(31.4)	42.2
	70—79	171	148±26	83±13	68(39.8)	51.7
	80—	55	150±24	81±13	21(38.1)	
	Total	843	141±25	84±14	243(28.8)	
Women	30—39	108	119±14	72±10	2(1.9)	7.1
	40—49	447	125±18	77±12	33(7.4)	13.6
	50—59	569	133±23	80±12	86(15.1)	28.3
	60—69	482	143±23	83±12	117(24.2)	41.3
	70—79	235	151±25	82±13	70(29.8)	54.8
	80—	69	151±25	83±12	29(42.0)	
	Total	1,910	136±24	80±13	308(16.1)	

jurisdiction of SHC was low compared with that obtained in the basic survey on adult diseases conducted by the State in 1971 and 1972.

Obesity

The rate of occurrences of obesity detected at medical examination in an area within the jurisdiction of SHC in 1978 is shown in Table III. The degree of obesity was highest in the 40—49 age group in both men and women, with 18% for men and 21% for women. The rate of obesity decreased with aging. A proper weight was noted in about 50 percent in both men and women.

Serum Total Cholesterol

Serum total cholesterol levels could be determined in 690 persons in 14 districts (Table IV). The mean for cholesterol (6) increased with aging up

TABLE III. *Incidence of Obesity and Mean Value by Age*

Sex	Age	Persons examined	～−10% Incidence (%)	−9%～+9% Incidence (%)	+10%～+19% Incidence (%)	+20%～ Incidence (%)	Mean value ± SD
Men	30−39	28	3(10.7)	12(42.9)	10(35.7)	3(10.7)	7.6±10.2
	40−49	136	9(6.7)	66(48.5)	36(26.5)	25(18.4)	7.0±13.6
	50−59	224	21(9.4)	134(59.8)	45(20.1)	24(10.7)	3.5±12.7
	60−69	229	43(18.8)	123(53.7)	41(17.9)	22(9.6)	2.0±12.1
	70−79	171	45(26.3)	96(56.1)	20(11.7)	10(5.8)	1.1±11.4
	80−	55	20(36.4)	31(56.4)	2(3.6)	2(3.6)	7.7±9.9
	Total	843	141(16.7)	462(54.8)	154(18.3)	86(10.2)	2.2±13.9
Women	30−39	108	10(9.3)	54(50.0)	26(24.1)	18(16.7)	4.5±12.7
	40−49	447	26(5.8)	227(50.8)	99(22.1)	95(21.3)	8.0±12.3
	50−59	569	70(12.3)	266(46.7)	132(23.2)	101(17.8)	6.1±13.7
	60−69	483	70(14.5)	245(50.7)	91(18.8)	77(15.9)	4.5±13.1
	70−79	235	65(27.7)	115(48.9)	35(14.9)	20(8.5)	0.7±17.1
	80−	69	15(21.7)	39(56.9)	7(10.1)	8(11.6)	0.8±12.3
	Total	1,911	256(13.4)	946(49.5)	390(20.4)	319(16.7)	5.2±13.5

TABLE IV. *Serum Cholesterol Levels*

Sex	Age	No. of persons examined	～159mg/dl (%)	160～219mg/dl (%)	220～mg/dl (%)	Mean value ± SD mg/dl
Men	30−39	12	6(50.0)	5(41.7)	1(8.3)	163±31
	40−49	40	9(22.5)	29(72.5)	2(5.0)	179±27
	50−59	86	25(29.1)	53(61.6)	8(9.3)	175±33
	60−69	75	13(17.3)	52(69.3)	10(13.3)	185±32
	70−79	71	23(32.4)	36(50.7)	12(16.9)	181±35
	80−	24	8(33.3)	14(58.3)	2(8.3)	171±33
	Total	308	84(27.3)	189(61.4)	35(11.4)	179±33
Women	30−39	63	30(47.6)	30(47.6)	3(4.8)	164±27
	40−49	131	11(8.4)	94(71.8)	26(19.8)	198±32
	50−59	132	11(8.4)	90(68.3)	31(23.5)	200±32
	60−69	136	6(4.4)	78(57.4)	52(38.2)	209±34
	70−79	94	11(11.7)	57(60.6)	26(27.6)	198±32
	80−	26	3(11.5)	18(69.2)	5(19.2)	188±29
	Total	582	72(12.4)	367(63.0)	143(24.6)	197±34

to 69 years of age in both men and women, and tended to decline at about age 70 or older. The levels were higher in women than in men (7−9).

Electrocardiogram (ECG)

Of those who underwent the medical examination in 1977 and 1978, 2,600 persons subjected to ECG examination were evaluated, using the Minnesota code.

With the ECG findings divided into the hypertensive changes (High $R_{1\cdot3}$ $+ST_{1-3}T_{1-5}$), ischemic changes ($QS_{1\cdot2}$ or $ST_{1-3}T_{1-3}$) and other abnormal

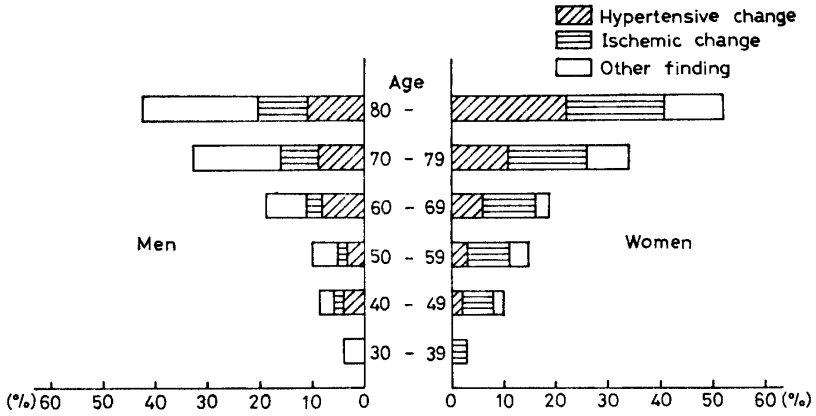

Fig. 6. Rate of abnormal ECG findings with age.

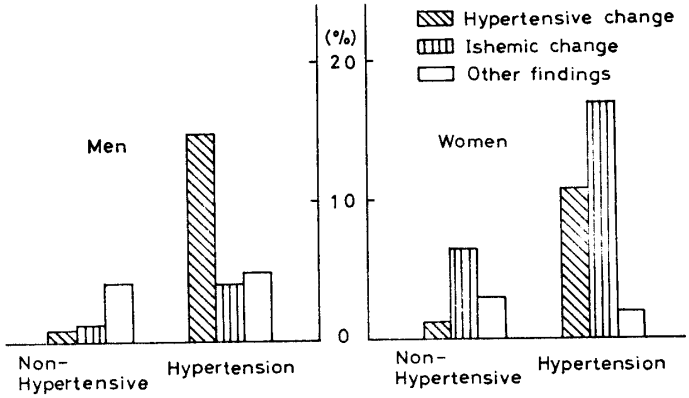

Fig. 7. Hypertension and ECG findings.

findings (A-$V_{1\cdot2}$, V_1, Arythmic$_{1-3}$), the rate of abnormal findings age (Fig. 6) and the rate of abnormal findings in blood pressure (Fig. 7) were presented. The number of persons with the abnormal findings increased with aging, in both men and women (3).

The percentage of hypertensive related changes was high in men up to 69 years and in women aged 70 or over. When persons under 64 years of age were divided into the hypertensive and non-hypertensive groups and the incidence of abnormal findings on ECG was examined, the percentage of changes was significantly higher in the hypertensive than in the non-hypertensive, for both men and women (4).

Ischemic changes likewise showed a significantly high percentage in the hypertensive patients. When a comparison was made of the rate of abnormal findings between men and women among the hypertensives, the percentage of hypertensive related changes was high in men while the rate of ischemic changes was high in women.

4. Diet

A nutrition survey was conducted 13 times and was based on the household-wise counting formula conducted 11 times and by an interview carried out in 1978 and 1979.

The breakdown of nutrients ingested is shown in Fig. 8—1 and 8—2.

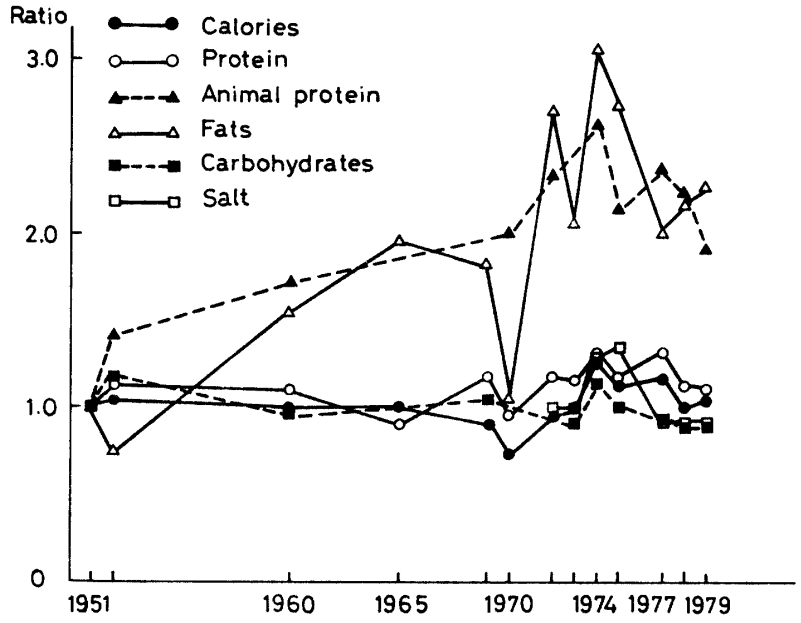

Fig. 8—1.* Changes in intake of meal by nutritive elements. Beakdown in the intake of food by nutritive elements for 1972 : total cal 2300, protein 76g, animal protein 22g, fat 22g, carbohydrate 420g and table salt 18g.

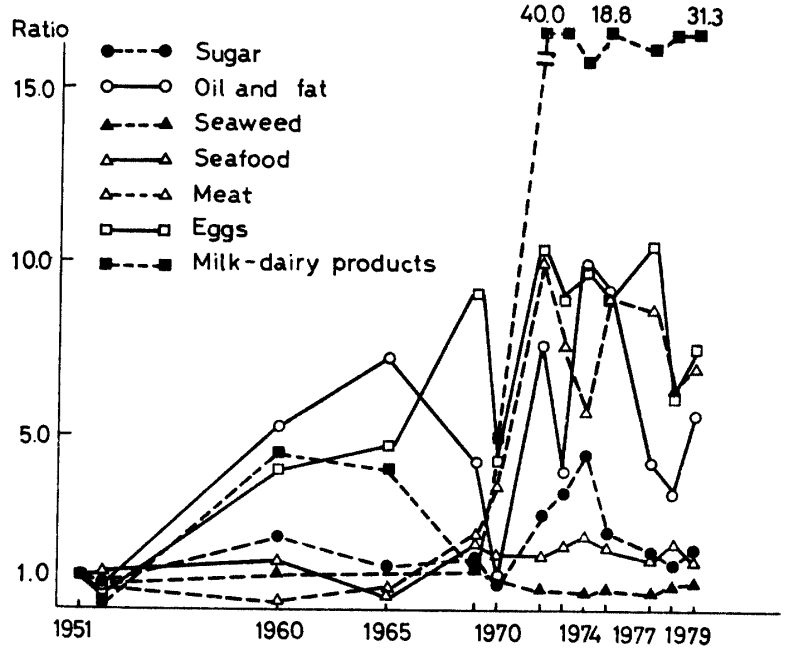

Fig. 8—2.* Changes in intake of meal by foods. Beakdown in the take of food by nutritive elements for 1951 : sugar 12g, oil and fat 3g, seaweed 15g, seafood 97g, animal meat 5g, eggs 6g and milk-dairy products 4g.

* Chronological changes in intake of each nutrient and group of foods are shown in Figs. 8—1 and 8—2 with the ratio of increase compared to levels of intake of those in 1951, as an unit.

Characteristically, the intake of animal protein and fats tended to increase gradually year by year, except for lipids in 1970, and increased by a little more than double from around 1972.

Dairy products added to the diet increased markedly from around 1972. In 1952 120g/day of seafood was included in the diet, but from around 1960 lipids, fats and eggs were increasingly added to the diet.

DISCUSSION

The crude mortality rate from cerebral apoplexy in Shimane Prefecture is one of the highest in all Japan (10).

In this isolated island in Shimane Prefecture, the crude mortality rate is high but the age-adjusted mortality rate is low. This is consistent with the finding that the mean blood pressure level and the incidence of hypertension are low in this island (11).

When compared with results of a nation-wide survey by Komachi *et al.* (3), however, it was all but equal to the mean blood pressure level for the group with low blood pressure levels.

As young Japanese now move to the large cities to work, most of the population is elderly, therefore, the adjusted incidence of the middle-aged is higher than that of aged, in opposition to other epidemiological surveys (4).

Studies of physical labor, diet and environment are required to clearly define differences in death rates between the elderly and the middle-aged.

As for the entry into the death certificate in this locality, the course from the onset of disease to death is accurately recorded as there is a close relationship between the inhibitants and doctors.

We estimated the period from the onset and month at onset on the basis of the death certificate. This is therefore an analysis not of the survivors but of those who died.

When cerebral apoplexy occurs among the young, the period up to death is short, suggesting that a major attack has occurred. In elderly persons, the period from the onset to the death is long, implicating that the attack was minor (4−5).

The month at onset appears to be related to physical labor and stress, in the middle aged, and to cold stress among the elderly persons.

However, this is not based on an exact investigation regarding the onset of the disease. We plan to establish the time of onset and clarify the symptoms at onset and situation at onset by a door-to-door survey conducted by public health nurses.

If the results of such an approach concur with findings on the death certificate, then utilization of this certificate will be valid.

Komachi *et al.* studied the ECG findings of persons who had cerebrovascular accidents and reported that the incidence was high in those with other complications when the blood pressure levels were the same, thereby stressing

the usefulness of ECG (3).

As mentioned earlier, the mean blood pressure level and the incidence of hypertension are low among the islanders. Thus, the fact that the incidence of ECG findings is low is consistent with the low corrected mortality rate in this island.

As to the relationship between cerebral apoplexy and intake of protein, a diet low in animal protein is said to be a contributing factor related to the prevention of cerebral apoplexy (3).

Though there seem to be limitations in interpretation of the results of the nutrition survey the results do reflect overall trends of changes in food intake. Results of this nutrition survey show that the intake of protein from seafood has been high for the past 20 or more years. This may possibly account for the low mortality from cerebral apoplexy.

Regarding the relationship between hypertension and the use table salt, nothing definite can be said because old data are not available. Salt seems to be mainly used in preserving food since the island is isolated (12). There is a marked yearly increase in the intake of milk and products followed by eggs, seafood and animal meat.

This change in the dietary life has probably something to do with the low death rate from cerebral apoplexy.

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