原著：

Differences in Dietary Factors among Areas in a Small City in Japan

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To study differences in dietary factors among communities with different living environments, we carried out a survey by the Cardiac Study method in 241 people (106 men and 135 women) aged between 50 and 54 years who were selected by random sampling from a total of 37,000 inhabitants in a small city. The city was geographically divided into town, flatland farming area, and mountainous farming area, and the results of the survey were compared among these areas.

The mean Na excretion in 24-hour specimens of urine was slightly higher in the mountainous farming area than in the other two-areas. The mean serum total cholesterol was higher in men in the town than in those in the other areas.

Factor analysis of the data for nutrient intake patterns revealed a lower fat intake in the two farming areas than in the town in the men, and a higher intake of animal foods in the town and a lower fat intake in the mountainous area in the women.

These results show that risk factors for circulatory diseases such as urinary Na excretion, serum cholesterol level, and nutrient intake patterns differ even among small areas if the living environment differs.

(1)Cardiac study (2)Random sampling (3)Dietary survey (4)Health examination for circulatory diseases (5)Differences among areas in a small city

INTRODUCTION

Circulatory diseases such as cerebrovascular diseases and ischemic heart diseases are biologically the results of aging but closely associated with living habits (especially eating habits). Shigitani and Komachi¹⁾ reported that different eating habits between the urban and rural districts result in a difference in the incidence of circulatory diseases, especially that of cerebrovascular diseases. We carried out a health examination and dietary survey in inhabitants of a small city to find out how dietary

factors differ among areas with different life styles.

MATERIALS AND METHODS

Oyabe City located in the western part of Toyama Prefecture is a small city with a population of 37,000 and an area of 112 km². One part consists of a business district and residential district, but most of the area is farming land, with rice as main crop. Then we divided the city geographically into town (commercial and residential districts) comprising 30% of the total population, flatland farming area (40%) and mountainous farming area (30%).

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According to the population of each area, 403 inhabitants aged 50–54 years (185 men and 218 women) were selected by random sampling. Inhabitants were individually requested, in the order of selection, to participate in the study until the number of samples allotted for each area was obtained. A total of 106 men and 135 women participated in the survey performed between January and April, 1986. On weekdays in principle, measurement of blood pressure, collection of blood and 24-hour urine, physical examinations, interviews, and dietary investigation were carried out.

All the investigations except for that of diet were performed by the CARDIAC Study method²⁾. CARDIAC STUDY (Cardiovascular Diseases and Alimentary Comparison Study) is the international cooperative study to investigate the relationship of dietary factors to blood pressure and other major cardiovascular diseases in widely different populations. The purpose of this study is to test specific hypotheses linking the intake of certain dietary constituents, such as sodium (Na), potassium (K), calcium (Ca), protein and lipid, to blood pressure and the relationship between dietary factors and mortality from cardiovascular diseases. Forty centers in 20 countries (Oyabe is one of the centers in Japan) are participating in CARDIAC Study. CARDIAC Study methods are summarized here briefly. From each population 100 males and 100 females at the age of 50 to 54 were randomly selected for blood pressure measurement by automated system, 24-hour urine collection by aliquot cup, blood sampling, and all samples were analyzed at a WHO Collaborating Center by Standard methods. Namely, blood pressure was measured with Sasaki's Automated blood pressure measurement system on the right arm in the sitting position after a five minute rest. Diastolic blood pressure was determined as the 5th-Korotokoff phase. Serum total protein, albumin, transaminase (GOT, GPT), gamma-glutamyl transpeptidase (γ -GTP), total cholesterol and uric acid were analyzed with SMAC III Autoanalyser (Technicon). Hemoglobin was analyzed with THMS H6000 Autoanalyser (Technicon). 24-hours urine specimens were analyzed for sodium and potassium by flame photometry. The

results were compared among the three areas.

In dietary investigation, dietary intakes during the last week were recalled by a dietician interviewer using a questionnaire produced by the Toyama Health Promoting Center³⁾. Participants were asked the frequencies and quantities of every item of food and drink which they had eaten over the last seven-day period. These food and drink items were converted to nutrient equivalents using the STANDARD TABLES OF FOOD COMPOSITION IN JAPAN (FOURTH REVISED EDITION).⁴⁾ The dietary data were analyzed by the factor analysis with varimax rotation for dietary intake patterns, and the obtained factor scores were compared among the areas. All data were processed on the computer FACOM, M-360. SAS (Statistical Analysis System) programs were used for statistical analysis.

RESULTS

No differences were found in the mean body mass index or blood pressure between the 3 areas (Table 1). The number of subjects with hypertension (systolic pressure ≥ 160 mmHg or diastolic pressure ≥ 95 mmHg) including 22 under treatment for hypertension was about the same between the three areas.

Blood analysis revealed significant differences among the men in the three areas; the mean total cholesterol level was higher in the town than in the flatland or mountainous farming area, and the mean serum albumin was lower in the mountainous farming area though the serum total protein did not differ. The other hematological findings in the men or women were similar among the different areas.

The mean Na excretion in 24-hour urine specimens of the men was slightly higher in the mountainous farming area and slightly lower in the town and flatland farming area, but in the women, no significant difference was found between the three areas. Urinary K excretion and Na/K ratio for the men or women did not differ either among the three areas.

The indices of the state of nutrition were those of intakes of total energy, total protein, animal protein, vegetable protein, total fat, animal fat,

Table 1 Comparison of serum and urinary values and other general health data among subjects grouped by area and sex.

		Men			Women		
		town	flatland farming area	mountaneous farming area	town	flatland farming area	mountaneous farming area
No. of Subjects		32	30	44	30	35	70
Body Mass Index	(kg/m ²)	23.8±3.4	23.3±2.6	23.8±3.1	24.0±3.5	24.3±3.5	24.0±3.1
Systolic Blood Pressure	(mmHg)	134±22	132±21	127±16	126±18	125±18	123±21
Diastolic Blood Pressure	(mmHg)	83±13	84±14	81±12	79±15	78±11	78±16
Blood Analysis							
No. of Subjects		32	30	44	30	35	69
Hemoglobin	(g/dl)	14.8±1.2	15.0±1.1	14.6±1.2	12.6±1.3	13.3±0.9	13.2±1.2
Serum Total Protein	(g/dl)	7.3±0.4	7.3±0.3	7.3±0.4	7.4±0.3	7.5±0.4	7.6±0.5
Albumin	(g/dl)	4.5±0.2	4.6±0.2	4.4±0.2**	4.5±0.2	4.6±0.2	4.5±0.2
Cholesterol	(mg/dl)	205±41	187±29	185±30*	212±28	208±33	209±33
Uric Acid	(mg/dl)	5.4±1.3	5.4±1.5	5.1±1.0	41±1.0	3.9±0.9	3.8±0.9
GOT	(U/l)	24.5±4.8	26.5±7.6	27.3±11.1	24.3±7.1	21.7±4.8	21.9±7.4
GPT	(U/l)	28.5±12.5	28.5±11.7	24.0±11.8	22.3±13.3	19.4±9.3	17.7±10.5
γ-GTP	(U/l)	33.2±29.0	38.8±28.4	33.4±47.7	12.9±5.7	12.9±5.3	13.1±6.8
Urine Analysis							
No. of Subjects		25	25	33	27	33	56
Na	(mEq/day)	232±70	228±80	255±91	218±60	212±88	222±73
K	(mEq/day)	44±14	43±11	47±14	45±15	50±23	43±14
Na/K		5.5±1.6	5.4±1.7	5.6±1.9	5.1±1.8	4.6±2.0	5.5±1.9

*, ** Significant differences among three areas by means of one-way analysis of variance (*P<0.05, **P<0.01)

Table 2 Rotated factor pattern used 14 variables of Nutrient intake by means of varimax method.

Item	Factor loading		
	Factor 1	Factor 2	Factor 3
Intake of energy	0.276	0.895	0.178
total protein	0.699	0.532	0.356
animal protein	0.901	0.115	0.343
vegetable protein	-0.010	0.873	0.174
total fat	0.464	0.141	0.844
animal fat	0.860	0.100	0.400
vegetable fat	-0.046	0.135	0.960
carbohydrate	-0.050	0.925	-0.223
animal protein / total protein	0.848	-0.347	0.216
animal fat / total fat	0.868	-0.059	-0.369
energy / R.D.A. energy	0.173	0.757	0.399
protein / R.D.A. protein	0.657	0.491	0.455
fat / R.D.A. fat	0.366	0.088	0.874
carbohydrate / R.D.A. carbohydrate	-0.136	0.709	0.070

R.D.A. : Recommended Dietary Allowance

vegetable fat, carbohydrate and the ratios of animal protein/total protein, animal fat/total fat, total energy/recommended dietary allowance (R. D. A.) for energy, total protein/R. D. A. protein, total fat/R. D. A. fat, and carbohydrate/R. D. A. carbohydrate. Factor analysis of the dietary data using these indices revealed three factors with an eigenvalue of 1.0 or more (Table 2). The contribution ratios of Factors 1, 2, and 3 were 32, 30, and 25%, respectively. The factor loading of Factor 1 was high for intakes of total protein, animal protein, and animal fat, as well as the ratios of animal protein/total protein and animal fat/total fat, suggesting that this factor represents the intake of animal foods. The loading of Factor 2 was high for total energy, the carbohydrate intake that constitutes for the most part the total energy source as well as for vegetable protein intake, suggesting that this factor represents the intake of vegetable foods. The loading of Factor 3 was high for total fat and animal fat intake, suggesting that this represents fat intake. The mean scores for each factor were compared between the three areas (Fig. 1 and Fig. 2). In men,

the scores for fat intake (Factor 3) were lower in the flatland farming area and mountainous farming area than in the town, those for carbohydrate intake (Factor 2) were high in the mountainous farming area and low in the town, but those for animal food intake (Factor 1) did not differ between the 3 areas. In the women, the scores for animal food intake were high in the town and flatland farming area but low in the mountainous farming area, those for intake (Factor 2) were lower in the mountainous farming area than in the other two areas, and those for carbohydrate intake (Factor 2) were slightly lower in the town.

DISCUSSION

We have long been involved in the circulatory management of the inhabitants of Oyabe City. In the present study, no difference was observed in the body mass index, mean blood pressure, and the ratio of inhabitants with hypertension among areas with different living environments. This city has a cerebrovascular diseases registration system in which medical practitioners and doctors at hospitals

Fig. 1 Mean of factor scores (Factor 1 and Factor 2) in each area.

Fig. 2 Mean of factor scores (Factor 1 and Factor 3) in each area.

report patients with cerebrovascular diseases to the health center in each district^{5,6)}. Between 1977 and 1986, the annual incidence of cerebrovascular diseases decreased from 3.3/1000 in the general population (3.7 in men and 2.9 in women) during the former 5-year period to 2.6 (3.1 in men and 2.1 in women) during the latter 5-year period^{6,7)}.

Comparison of dietary factors associated with the development of circulatory diseases among areas with different living environments revealed a high serum cholesterol level in men, a high animal food intake in the women, and a low carbohydrate intake in the men in the town; a high urinary Na excretion in the men, a low fat intake in the men and women, and a high carbohydrate intake in the men and a high animal food intake in the women in the flatland farming area. Though the incidence of cerebrovascular diseases by these areas is still under investigation, the corrected death rates for cerebrovascular diseases between 1980 and 1984 using the age distribution and deaths in the entire Oyabe City as standards were 92, 108, and 96, and those of cardiovascular diseases were 81, 101, and 119, in the town, flatland farming area, and mountainous farming area, respectively⁸⁾. The death rate for cerebrovascular diseases was relatively high in the flatland farming area and that of cardiovascular diseases in the mountainous farming area, while rates for both diseases were low in the town. These differences among areas may be associated with living habits, mainly eating habits^{9,10)}. In farming areas, especially, mountainous farming areas, carbohydrate intake primarily from cereals is high but fat intake is low¹¹⁾. In addition, the conventional Japanese habit to take excessive salt still remains in rural areas of Japan¹²⁾. These factors seem to cause cerebrovascular diseases and cardiovascular diseases specific to Japan that are induced by hypertension rather than arteriosclerosis¹³⁾. In addition, rapid westernization in the Japanese diet has resulted in increases in the cholesterol level¹⁴⁾. In the present survey, the cholesterol level and fat intake in the town were not or high as those in the western countries, and the death rates for circulatory diseases were lower in the town than in the farming areas.

Our results show that the status of nutrient intake differs even among small areas if the living environment differs. Since these differences in dietary intake seem to affect the incidence of circulatory diseases, measures for circulatory diseases appropriate for the status of each small area are needed.

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一小都市内における地域別食事性因子の相違

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一農村小都市内での生活環境を異にする小地域間における食事性因子の違いを比較するために、人口3万7千人の小農村都市において、小地域別に層化無作為抽出した50-54歳の住民241人(男106人, 女135人)を対象にCARDIAC Studyにもとづいて栄養調査や循環器検診を行った。対象地域を市街地, 平地農村, 山間農村の3小地域に分け, 各地域間の調査成績の比較を行った。

24時間尿摂取法によって測定したNa排出量の平均値は男では山間農村が他2地域より高く、血清総コレステロールの平均値は男で市街地が他2地域より高くなる傾向がみられた。

栄養調査結果に基づいた因子分析では男で市街地より農村2地域で脂肪摂取因子が低く、女では市街地で動物性食品の摂取因子が高く、山間農村で脂肪摂取因子が低率となった。

以上の結果から、いかに小地域でも、生活環境が異なれば、尿中Na排泄量、血清コレステロールや栄養摂取状況などの循環器疾患危険因子が異なっているようである。

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