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Original article

Comparison of Regional Differences in Health Indicators and Standard Mortality Ratio for Stroke in Subjects in Ehime Prefecture

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Abstract

Objective: The purpose of this study was to investigate regional differences in the standard mortality ratio (SMR) and risk factors (including dietary habits) for stroke across the three regions of Ehime Prefecture – *Toyo* (east), *Chuyo* (central), and *Nanyo* (south).
Participants and methods: We obtained medical records derived from 956,979 medical examinations carried out at JA Ehime Kouseiren Medical Examination Centers between April 1994 and March 2006. We analyzed data from 132,090 subjects (*Toyo* - 47,654, *Chuyo* - 38,435, *Nanyo* - 46,001) who underwent their first medical examination during this period. To analyze differences between the three regions, we first calculated the SMR for stroke based on data from the Basic Residential Registers and Health Statistics Bureau. Secondly, we calculated significant differences in body mass index, systolic blood pressure (SBP), diastolic blood pressure (DBP), blood glucose (Glu), and total cholesterol (T-CHO). Thirdly, we used the Chi-square test to calculate significant differences in the percentage of subjects who consumed the following foods on a daily basis: rice, bread, eggs, fish, meat, vegetables, dairy products, and fruit juice.
Results: Despite the fact that regional differences in the SMR for stroke have been decreasing, in both men and women in *Nanyo*, the mean values for SBP and DBP were significantly higher and the mean value for T-CHO was significantly lower than in *Toyo* and *Chuyo*. In *Nanyo*, the percentage of subjects who consumed rice and fish (men and women), meat (men), and juice (women) on a daily basis was higher than in *Toyo* and *Chuyo*.
Conclusion: In *Nanyo,* higher SMR for stroke may be related to high SBP and DBP and low T-CHO. As background to these results, it is also thought that regional differences in dietary habits may have an influence.

Key words: standard mortality ratio of stroke, health indicators, diet, lifestyle, living environment

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Introduction

It is well established that stroke is one of the three most common causes of death in Japan[1)]. Recent studies have reported there is an association between the incidence of stroke and living environment[2, 3)]. The mortality rate of stroke is therefore not uniform throughout Japan and varies from prefecture to prefecture. Furthermore, within prefectures, it is well known that the mortality rate varies from city to city[4)]. The Westernization of the Japanese diet has lead to an increase in high blood pressure, diabetes mellitus and hyperlipidemia amongst Japanese people, and an increased rate of stroke has been reported[5)].

Ehime Prefecture is divided into three geographical regions: *Toyo* (east), *Chuyo* (central), and *Nanyo* (south). Each of these regions has its own specific industrial characteristics. *Toyo* is home to secondary industries such as paper, chemicals, shipbuilding and fiber pulp. *Chuyo* is the center of tertiary industries including commercial offices, tourism and other service industries. *Nanyo* is associated with primary industries including agriculture and is well known for aqua-farming of sea bream and yellow tail, and as the second largest producer of mikan oranges. It is possible that differences in the living environment and lifestyle of each region influence the mortality ratio of stroke. In order to re-

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spond precisely to the diversified needs of the residents of Ehime, the prefectural government has been carrying out the Ehime Residents Health Survey (ERHS) every five years since 1984 (1989, 1994, 1999, 2004, 2010). Approximately 2,000 people from 20 districts across Ehime were selected randomly to respond to the ERHS questionnaire. The ERHS survey has some issues: (1) the study does not compare the three regions of Ehime (*Toyo*, *Chuyo* and *Nanyo*), (2) the sample size is small, and (3) it is a one-off survey (not longitudinal). Because the ERHS utilizes a random sampling protocol, it is not suitable for carrying out comparative analysis of health indicators according to region. Furthermore, we have not identified any reports comparing the mortality rate of stroke and risk factors across the three regions of Ehime Prefecture.

Therefore, the objective of this study was to investigate regional differences in the mortality rate of, and risk factors for, stroke. We compared the following risk factors: mean value for body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose (Glu), and total cholesterol (T-CHO). We also compared dietary habits.

Participants and Methods

Subjects

This survey used data derived from medical examinations carried out between April 1994 and March 2006 across Ehime Prefecture by the JA Ehime Kouseiren Center for Medical Examination (JA-EKCME). Over this 13-year period, a total of 956,979 Ehime subjects underwent medical examinations, with 596,401 of these subjects having a blood test. We excluded 5771 subjects in the youngest (≤ 29 years old) and oldest (≥ 90 years old) age groups, as the number of each group was less than 1 percent of the total number of subjects. Where subjects had undergone multiple medical examinations during this period, we only used data from the subject's first recorded medical examination. In the end, we analyzed a dataset of 132,090 subjects, excluding 185 subjects whose questionnaires were incomplete.

The Ethics Committee of the Ehime Prefectural Federation of Agricultural Cooperatives for Health and Welfare approved this study prior to its implementation.

Study objectives

We calculated the standard mortality ratio (SMR) for stroke in all three regions of Ehime Prefecture (*Toyo*, *Chuyo*, *Nanyo*) over the period 1994 to 2006 based on the Basic Residential Registers and Health Statistics Bureau data. We used the total population of Ehime Prefecture in the year 2000 as a baseline population for calculating SMR using indirect age-adjusted death rate.

Data on BMI, physical measurements (height and weight), SBP, DBP, Glu, and T-CHO were analyzed. BMI was calculated as weight in kilograms / (height in meters)^2 and classified as follows: ≤ 18.4 kg/m^2 was classified as "underweight," 18.5–24.9 kg/m^2 was classified as "normal body weight," 25.0–29.9 kg/m^2 was classified as "Obese I," and ≥ 30.0 kg/m^2 was classified as "Obese II, III, and IV" [6]. The SBP values were classified as follows: ≤ 129 mmHg was classified as "normal range," 130–159 mmHg was classified as "high, requiring further examination," and ≥ 160 mmHg was classified as "high, requiring medical treatment" [7]. The DBP values were classified as follows: ≤ 84 mmHg was classified as "normal range," 85–99 mmHg was classified as "high, requiring further examination," and 100 mmHg was classified as "high, requiring medical treatment" [7]. The Glu levels were classified as follows: ≤109 mg/dL was classified as "normal range," 110-125 mg/dL was classified as "borderline diabetes mellitus," and ≥ 126 mg/dL was classified as "suspected diabetes mellitus" [8]. The T-CHO levels were classified as follows: ≤ 139 mg/dL was classified as "low, requiring medical treatment," 140–199 mg/dL was classified as "normal range," 200–259 mg/dL was classified as "high, requiring further examination," and ≥ 260 mg/dL was classified as "high, requiring medical treatment" [7]. JA-EKCME is a member of the Lipid Standardization Program maintained by the Centers for Disease Control (CDC) in Atlanta, GA, USA, and has received certification for accuracy in the testing of serum total cholesterol (T-CHO) levels.

We also carried out a questionnaire survey covering the following areas: age, occupation, dietary habits, history of treatment for stroke and whether or not the subject was on medication for hypertension, diabetes mellitus, or hyperlipidemia. The food intake survey covered the following food groups: rice, bread, eggs, fish, meat, vegetables, dairy products, and juice. Subjects filled out a questionnaire on the frequency of consumption of the food groups (occasionally, 1–2 days per week, 3–4 days per week, 5–6 days per week, or daily).

Statistical analysis

We analyzed each level of significance of the SMR for stroke for each year from 1994 to 2006 using the following formula: value of the SMR for stroke ± 1.96 × value of the SMR for stroke divided by the square root of the number of people deceased.

Using the Chi-square test, we inquired into whether or not there was a significant difference in the following factors for subjects of the three regions: (1) age, (2) occupation, (3) BMI, (4) SBP, (5) DBP, (6) Glu, (7) T-CHO, (8) consumption of the eight food groups, and (9) the prevalence

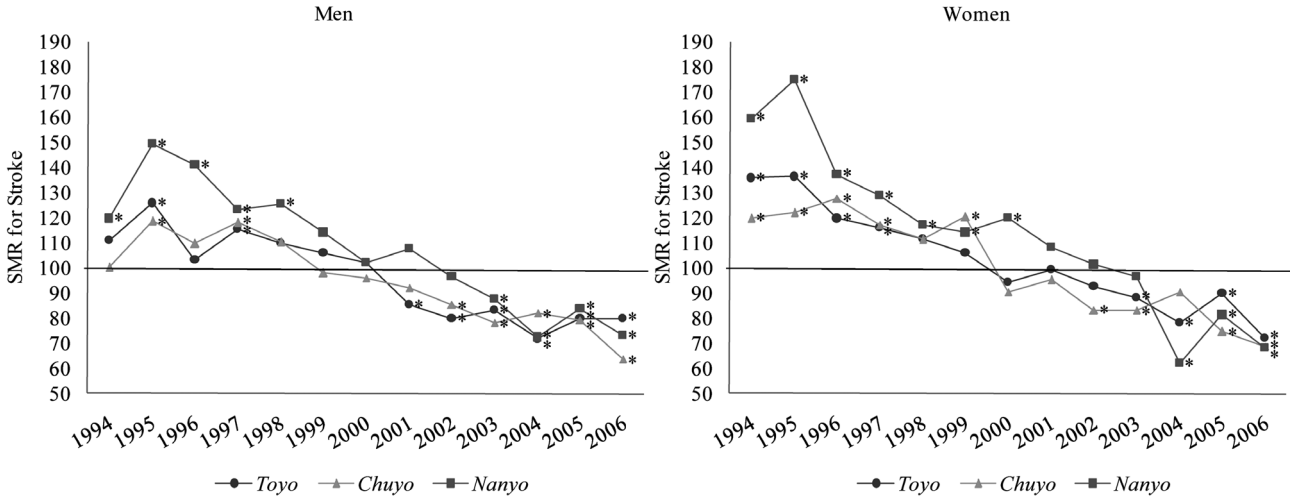

Figure 1 The standard mortality ratio (SMR) for stroke, grouped according to sex, in all three regions (*Toyo*, *Chuyo*, *Nanyo*) of Ehime Prefecture over the period 1994 to 2006. The value of "100" for SMR for stroke represents the standard value based on the baseline population of Ehime Prefecture in 2000. For each year from 1994 to 2006, when the value of the SMR for stroke was over 100 and the range of the 95% confidential interval (CI) extended beyond 100, there was a statistically significant difference in the value of the SMR for stroke. Similarly, when the SMR for stroke was under 100 and the range of the 95% CI fell within 100, there was also a significant difference in the value of the SMR for stroke.

rate of stroke. Using one-way analysis of variance, we analyzed whether or not there was a significant difference in the mean value for BMI between the three regions. To take into account that the medications used to treat hypertension, diabetes mellitus and hyperlipidemia were confounding factors, we used analysis of covariance and calculated a mean value for SBP, DBP, Glu, and T-CHO for the three regions of Ehime. Multiple comparisons were performed using the Bonferroni correction. The statistical analyses were carried out using SPSS Version 19 (IBM Japan), with P values ≤ 5% implying statistically significant differences.

Results

Regional differences in mortality ratio for stroke

In comparison with the baseline value of 100 for SMR in Ehime Prefecture in 2000, the SMR for male stroke in *Toyo* was significantly higher in 1995 and 1997 and lower in 2001-2006 (Figure 1). The SMR for female stroke in *Toyo* was significantly higher in 1994-1997 and lower in 2003-2006. The SMR for male stroke in *Chuyo* was significantly higher in 1995 and 1997 and lower in 2002–2006. The SMR for female stroke in *Chuyo* was significantly higher in 1994-1997 and 1999 and lower in 2002, 2003, 2005, and 2006. The SMR for male stroke in *Nanyo* was significantly higher in 1994-1998 and lower in 2003-2006. The SMR for female stroke in *Nanyo* was significantly higher in 1994–2000 and lower in 2004–2006.

Risk factors for stroke in subjects

We analyzed the data from 132,090 subjects: 16,480 men and 31,174 women from *Toyo*, 12,462 men and 25,973 women from *Chuyo*, and 18,018 men and 27,983 women from *Nanyo* (Table 1). According to the JA-EKCME questionnaire, the number of men who reported that they had suffered a stroke was as follows: *Toyo* 190 (1.2%), *Chuyo* 153 (1.2%), and *Nanyo* 420 (2.3%) (χ^2 value = 164.558, $p<0.001$). The number of women who reported that they had suffered a stroke was as follows: *Toyo* 133 (0.4%), *Chuyo* 132 (0.5%), and *Nanyo* 261 (0.9%) (χ^2 value = 62.787, $p<0.001$). There was a significant difference between the five age groups, for both men and women in the three regions, using the Chi-square test. There was a significant difference in the six occupation groups, for both men and women in the three regions, using the Chi-square test. Because subjects over the age of 60 represent the largest age group, it follows that a large number of people fall within the occupation group "Other" (which includes people who are homemakers and those who are retired). However, the most common occupation for men in Nanyo was farming – 44.4% of men were engaged in farming. Using the Chi-square test, we established that there was a significant difference in the risk factors - BMI, SBP, DBP, Glu, T-CHO, and consumption of eight food groups - between the three regions.

Table 1 Demographic characteristics of the subjects

	Men				Women			
	Toyo (*N* = 16,480)	*Chuyo* (*N* = 12,462)	*Nanyo* (*N* = 18,018)	P Value	*Toyo* (*N* = 31,174)	*Chuyo* (*N* = 25,973)	*Nanyo* (*N* = 27,983)	P Value
Age group, *N* (%)				0.000				0.000
30–39 yr	1,065 (6.5)	653 (5.2)	1,481 (8.2)		3,048 (9.8)	1,540 (5.9)	2,610 (9.3)	
40–49 yr	2,293 (13.9)	1,424 (11.4)	2,968 (16.5)		5,620 (18.0)	5,068 (19.5)	4,623 (16.5)	
50–59 yr	2,989 (18.1)	2,205 (17.7)	3,696 (20.5)		8,362 (26.8)	7,539 (29.0)	6,750 (24.1)	
60–69 yr	7,391 (44.8)	5,684 (45.6)	6,571 (36.5)		10,464 (33.6)	8,688 (33.5)	9,384 (33.5)	
70–79 yr	2,742 (16.6)	2,496 (20.0)	3,302 (18.3)		3,680 (11.8)	3,138 (12.1)	4,616 (16.5)	
Occupation, *N* (%)				0.000				0.000
Farming	4,549 (27.6)	4,509 (36.2)	8,000 (44.4)		4,709 (15.1)	5,532 (21.3)	8,143 (29.1)	
Forestry	33 (0.2)	73 (0.6)	144 (0.8)		8 (0.0)	6 (0.0)	28 (0.1)	
Fishery	148 (0.9)	60 (0.5)	577 (3.2)		96 (0.3)	45 (0.2)	448 (1.6)	
Office work	2,488 (15.1)	1,257 (10.1)	2,198 (12.2)		2,643 (8.5)	1,543 (5.9)	2,463 (8.8)	
Self-owned business	2,159 (13.1)	1,244 (10.0)	1,802 (10.0)		1,482 (4.8)	950 (3.7)	1,371 (4.9)	
Others (retired, house-keeping, etc)	7,103 (43.1)	5,319 (42.7)	5,297 (29.4)		22,236 (71.3)	17,897 (68.9)	15,530 (55.5)	
BMI group, *N* (%)				0.065				0.000
≤ 18.4	681 (4.1)	583 (4.7)	796 (4.4)		1,738 (5.6)	1,425 (5.5)	1,733 (6.2)	
18.5–24.9	11,240 (68.2)	8,540 (68.5)	12,347 (68.5)		21,210 (68.0)	18,226 (70.2)	19,310 (69.0)	
25.0–29.9	4,219 (25.6)	3,130 (25.1)	4,521 (25.1)		7,266 (23.3)	5,671 (21.8)	6,201 (22.2)	
≥ 30.0	340 (2.1)	209 (1.7)	354 (2.0)		960 (3.1)	651 (2.5)	739 (2.6)	
SBP group, *N* (%)				0.000				0.000
≤ 129	6,701 (40.7)	5,060 (40.6)	6,688 (37.1)		15,457 (49.6)	13,032 (50.2)	12,074 (43.1)	
130–159	7,845 (47.6)	6,030 (48.4)	8,967 (49.8)		12,639 (40.5)	10,801 (41.6)	12,544 (44.8)	
≥ 160	1,934 (11.7)	1,372 (11.0)	2,363 (13.1)		3,078 (9.9)	2,140 (8.2)	3,365 (12.0)	
DBP group, *N* (%)				0.000				0.000
≤ 84	12,129 (73.6)	8,613 (69.1)	11,961 (66.4)		25,349 (81.3)	20,582 (79.2)	21,421 (76.6)	
85–99	3,548 (21.5)	3,279 (26.3)	4,934 (27.4)		4,934 (15.8)	4,758 (18.3)	5,616 (20.1)	
≥ 100	803 (4.9)	570 (4.6)	1,123 (6.2)		891 (2.9)	633 (2.4)	946 (3.4)	
Glu group, *N* (%)				0.000				0.000
≤ 109	13,411 (81.4)	9,844 (79.0)	14,329 (79.5)		28,005 (89.8)	23,215 (89.4)	24,608 (87.9)	
110–125	1,469 (8.9)	1,252 (10.0)	1,766 (9.8)		1,663 (5.3)	1,587 (6.1)	1,813 (6.5)	
≥ 126	1,600 (9.7)	1,366 (11.0)	1,923 (10.7)		1,506 (4.8)	1,171 (4.5)	1,562 (5.6)	
T-CHO group, *N* (%)				0.000				0.000
≤ 139	515 (3.1)	420 (3.4)	734 (4.1)		476 (1.5)	333 (1.3)	498 (1.8)	
140–199	7,750 (47.0)	5,968 (47.9)	9,325 (51.8)		10,723 (34.4)	8,657 (33.3)	10,740 (38.4)	
200–259	7,252 (44.0)	5,404 (43.4)	7,133 (39.6)		16,183 (51.9)	13,873 (53.4)	14,099 (50.4)	
≥ 260	963 (5.8)	670 (5.4)	826 (4.6)		3,792 (12.2)	3,110 (12.0)	2,646 (9.5)	
Frequency of consumption of the eight food groups per week in the subjects, *N* (%)								
Rice				0.000				0.000
0–6 days per week	357 (2.2)	380 (3.0)	308 (1.7)		793 (2.5)	883 (3.4)	590 (2.1)	
Daily	16,123 (97.8)	12,082 (97.0)	17,710 (98.3)		30,381 (97.5)	25,090 (96.6)	27,393 (97.9)	
Bread				0.000				0.000
0–6 days per week	12,260 (74.4)	8,956 (71.9)	14,009 (77.8)		22,273 (71.4)	17,691 (68.1)	20,612 (73.7)	
Daily	4,220 (25.6)	3,506 (28.1)	4,009 (22.2)		8,901 (28.6)	8,282 (31.9)	7,371 (26.3)	
Eggs				0.000				0.000
0–6 days per week	11,103 (67.4)	10,183 (81.7)	14,227 (79.0)		24,417 (78.3)	19,913 (76.7)	21,867 (78.1)	
Daily	5,377 (32.6)	2,279 (18.3)	3,791 (21.0)		6,757 (21.7)	6,060 (23.3)	6,116 (21.9)	
Fish				0.000				0.000
0–6 days per week	13,237 (80.3)	10,283 (82.5)	11,741 (65.2)		26,862 (86.2)	21,916 (84.4)	18,117 (64.7)	
Daily	3,243 (19.7)	2,179 (17.5)	6,277 (34.8)		4,312 (13.8)	4,057 (15.6)	9,866 (35.3)	
Meat				0.000				0.000
0–6 days per week	10,205 (61.9)	7,497 (60.2)	10,569 (58.7)		19,970 (64.1)	15,546 (59.9)	17,599 (62.9)	
Daily	6,275 (38.1)	4,965 (39.8)	7,449 (41.3)		11,204 (35.9)	10,427 (40.1)	10,384 (37.1)	
Vegetables				0.000				0.000
0–6 days per week	4,329 (26.3)	2,890 (23.2)	5,002 (27.8)		7,383 (23.7)	4,274 (16.5)	6,269 (22.4)	
Daily	12,151 (73.7)	9,572 (76.8)	13,016 (72.2)		23,791 (76.3)	21,699 (83.5)	21,714 (77.6)	
Dairy products				0.000				0.000
0–6 days per week	12,077 (73.3)	8,571 (68.8)	13,233 (73.4)		21,045 (67.5)	15,461 (59.5)	19,074 (68.2)	
Daily	4,403 (26.7)	3,891 (31.2)	4,785 (26.6)		10,129 (32.5)	10,512 (40.5)	8,909 (31.8)	
Juice				0.000				0.000
0–6 days per week	12,928 (78.4)	10,453 (83.9)	14,298 (79.4)		28,721 (92.1)	24,124 (92.9)	25,282 (90.3)	
Daily	3,552 (21.6)	2,009 (16.1)	3,720 (20.6)		2,453 (7.9)	1,849 (7.1)	2,701 (9.7)	

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; Glu, fasting blood glucose; T-CHO, total cholesterol. All statistically significant differences in the Table 1 were identified with the Chi-square test. A p value of 0.05 or less indicates statistical significance.

The percentage of subjects in the category "consumed all eight foods on a daily basis" was significantly different between the three regions. The percentage for both men and women in the category "eat rice daily" tended to be higher in *Nanyo* than in *Toyo* and *Chuyo*, while for the category "eat bread daily," the percentage tended to be higher in *Chuyo* than in *Nanyo* and *Toyo*. The percentage of subjects in the category "eat eggs daily" tended to be higher for men in *Toyo* than in *Chuyo* and *Nanyo*, and tended to be higher for women in *Chuyo* than in *Nanyo* and *Toyo*. In the category "eat fish daily," the percentage for both men and women tended to be higher in *Nanyo* than in *Toyo* and *Chuyo*, while the category "eat meat daily" tended to be higher for men in *Nanyo* than in *Toyo* and *Chuyo*, and higher for women in *Chuyo* than in *Nanyo* and *Toyo*. The percentage for both men and women in the category "eat vegetables daily" tended to be higher in *Chuyo* than in *Nanyo* and *Toyo*. The percentage of subjects in the category "consumed dairy products daily" tended to be higher for men in *Chuyo* than in *Nanyo* and *Toyo*, and tended to be higher for women in *Toyo* than in *Chuyo* and *Nanyo*. The percentage of subjects in the category "drink juice daily" tended to be higher for men in *Toyo* than in *Chuyo* and *Nanyo*, and tended to be higher for women in *Nanyo* than in *Toyo* and *Chuyo*.

Because the health indicators (BMI, SBP, DBP, Glu, T-CHO) were influenced by age, in further analysis, we analyzed them by age group (Table 2). There was a significant difference between regions in mean BMI in women. Multiple comparisons showed that for women in their 50s, 60s, and 70s, the mean value for BMI in *Toyo* was significantly higher than in *Nanyo*. For women in their 30s, 40s, 50s, and 60s, the mean value for BMI in *Toyo* was significantly higher than in *Chuyo*. The mean value for BMI in *Toyo* was significantly higher than in *Chuyo* and *Nanyo*. There was a significant difference between regions in mean SBP for both men and women. Multiple comparison showed that for men and women in their 30s, 40s, 50s, and 60s, the mean value for SBP in *Nanyo* was significantly higher than in *Toyo*. In men in all age groups, the mean value for SBP in *Nanyo* was significantly higher than in *Chuyo*. In women in their 40s, 50s, 60s, and 70s, the mean value for SBP in *Nanyo* was significantly higher than in *Chuyo*. The mean value for SBP in *Nanyo* was significantly higher than in *Toyo* and *Chuyo*. There was a significant difference in mean DBP in both men and women between regions. Multiple comparison showed that in men and women in their 30s, 40s, 50s, and 60s, the mean value for DBP in *Nanyo* was significantly higher than in *Toyo* and *Chuyo*. There was no significant difference between regions in the mean value for Glu in both men and women. There was a significant difference between regions in mean T-CHO for both men and women. Multiple comparison showed that in men in their 60s and 70s and women in all age groups, the mean value for T-CHO in *Nanyo* was significantly lower than in *Chuyo*. In men in their 50s, 60s, and 70s and women in their 40s, 50s, 60s, and 70s, the mean value for T-CHO in *Nanyo* was significantly lower than in *Toyo*. The mean value for T-CHO in *Nanyo* was significantly lower than in *Toyo* and *Chuyo*. In this study, it became clear that in *Nanyo*, the mean values for SBP and DBP in both men and women were higher and the mean value for T-CHO was lower than in *Toyo* and *Chuyo*.

Discussion

The mortality rate of stroke varies from city to city within each prefecture. Ehime Prefecture is divided into three geographical regions: *Toyo* (east), *Chuyo* (central), and *Nanyo* (south), each with its own characteristic industries. It is our contention that not only differences in industry but also geographic differences between the three regions may affect the mortality rate of, and risk factors for, stroke. Because there are no studies investigating the mortality ratio of stroke and stroke risk factors between the three regions of Ehime Prefecture, in this study we compared the SMR for stroke and mean values for BMI, SBP, DBP, Glu, T-CHO, and dietary habits.

Our results showed that in *Nanyo*, the value for SMR over the period 1994 to 2006 exceeded the baseline of 100 five times in male stroke patients and seven times in female stroke patients (Figure 1). In *Toyo*, the SMR exceeded 100 only twice in male stroke patients and four times in female stroke patients, and in *Chuyo*, it exceeded 100 only twice in male stroke patients and five times in female stroke patients. The SMR for *Nanyo* declined over the period of 1994 to 2006; however, it was still higher than the SMR for *Chuyo* and *Toyo*. Of the three regions of Ehime, *Nanyo* had the highest rate of death from stroke. Further, analysis of self-reported incidence of stroke showed that *Nanyo* subjects had a higher prevalence rate of stroke than subjects from *Toyo* and *Chuyo*. *Nanyo* is associated with several primary industries. The percentage of subjects who engage in agriculture is higher in *Nanyo* than in *Toyo* and *Chuyo* (Table 1). Recent reports have shown that the farmers in the category "high, requiring medical treatment" for blood pressure[9], had higher fasting blood glucose[10] and total cholesterol[11] levels than non-farmers. Our results support the established view that there is a high incidence of stroke in rural areas.

A comparison of the risk factors for stroke showed that in *Nanyo*, the mean values for SBP and DBP and for T-CHO in both men and women were significantly higher and lower, respectively, than in either *Toyo* or *Chuyo*. It is well established that hypertension[12–14] and low T-CHO[15] are impor-

Table 2 Survey objectives of the subjects

	Men				Women			
	Toyo (*N* = 16,480)	*Chuyo* (*N* = 12,462)	*Nanyo* (*N* = 18,018)	P Value	*Toyo* (*N* = 31,174)	*Chuyo* (*N* = 25,973)	*Nanyo* (*N* = 27,983)	P Value
BMI (kg/m^2) [a]								
30–39	23.8 ± 3.3	23.8 ± 3.3	23.7 ± 3.4	0.524	21.4 ± 3.2	21.7 ± 3.2	21.5 ± 3.2	0.018
40–49	23.7 ± 3.2	23.7 ± 3.1	23.7 ± 2.9	0.748	22.9 ± 3.3	22.6 ± 3.1	22.8 ± 3.1	0.000
50–59	23.7 ± 2.9	23.6 ± 2.9	23.6 ± 2.9	0.158	23.4 ± 3.2	23.1 ± 3.1	23.3 ± 3.2	0.000
60–69	23.2 ± 2.9	23.2 ± 2.8	23.2 ± 2.9	0.128	23.5 ± 3.2	23.3 ± 3.2	23.3 ± 3.2	0.000
70–79	22.6 ± 2.9	22.6 ± 3.0	22.4 ± 3.0	0.005	23.1 ± 3.4	22.9 ± 3.3	22.8 ± 3.2	0.000
SBP (mmHg) [b]								
30–39	119.7 ± 0.4	120.0 ± 0.5	121.6 ± 0.3	0.001	110.5 ± 0.2	111.6 ± 0.3	112.3 ± 0.2	0.000
40–49	124.8 ± 0.3	124.9 ± 0.4	126.9 ± 0.3	0.000	120.5 ± 0.2	120.1 ± 0.2	122.1 ± 0.2	0.000
50–59	132.6 ± 0.3	131.2 ± 0.4	133.7 ± 0.3	0.000	130.3 ± 0.2	128.4 ± 0.2	131.4 ± 0.2	0.000
60–69	137.4 ± 0.2	136.5 ± 0.2	139.4 ± 0.2	0.000	137.1 ± 0.2	135.7 ± 0.2	138.8 ± 0.2	0.000
70–79	141.8 ± 0.4	139.9 ± 0.4	142.4 ± 0.3	0.000	142.2 ± 0.3	140.1 ± 0.3	143.0 ± 0.3	0.000
DBP (mmHg) [b]								
30–39	72.1 ± 0.3	73.8 ± 0.4	75.3 ± 0.3	0.000	66.1 ± 0.2	67.7 ± 0.2	69.0 ± 0.2	0.000
40–49	76.3 ± 0.2	78.8 ± 0.3	79.8 ± 0.2	0.000	71.9 ± 0.1	73.2 ± 0.1	74.3 ± 0.2	0.000
50–59	79.2 ± 0.2	80.6 ± 0.2	81.9 ± 0.2	0.000	76.4 ± 0.1	77.0 ± 0.1	78.6 ± 0.1	0.000
60–69	79.5 ± 0.1	80.4 ± 0.1	81.3 ± 0.1	0.000	77.5 ± 0.1	78.2 ± 0.1	79.2 ± 0.1	0.000
70–79	78.3 ± 0.2	78.7 ± 0.2	78.8 ± 0.2	0.165	76.8 ± 0.2	77.0 ± 0.2	77.1 ± 0.2	0.589
Glu (mg/dL) [b]								
30–39	91.4 ± 0.5	92.2 ± 0.6	91.9 ± 0.4	0.510	86.6 ± 0.3	88.2 ± 0.4	87.0 ± 0.3	0.002
40–49	98.0 ± 0.5	98.6 ± 0.7	98.5 ± 0.5	0.663	90.4 ± 0.2	90.5 ± 0.2	91.0 ± 0.3	0.229
50–59	103.7 ± 0.6	103.3 ± 0.7	103.5 ± 0.5	0.872	95.0 ± 0.2	94.6 ± 0.2	95.3 ± 0.2	0.173
60–69	103.8 ± 0.3	104.7 ± 0.4	105.0 ± 0.4	0.044	97.9 ± 0.2	98.2 ± 0.2	98.7 ± 0.2	0.031
70–79	104.0 ± 0.6	105.7 ± 0.6	105.6 ± 0.5	0.052	101.0 ± 0.4	101.0 ± 0.4	102.0 ± 0.3	0.090
T-CHO (mg/dL) [b]								
30–39	196.5 ± 1.1	196.0 ± 1.4	194.2 ± 0.9	0.227	180.7 ± 0.5	182.3 ± 0.8	179.9 ± 0.6	0.047
40–49	204.9 ± 0.8	204.0 ± 1.0	202.5 ± 0.7	0.069	199.8 ± 0.5	199.0 ± 0.5	194.9 ± 0.5	0.000
50–59	204.8 ± 0.7	202.4 ± 0.8	200.0 ± 0.6	0.000	222.4 ± 0.4	222.1 ± 0.4	217.3 ± 0.4	0.000
60–69	201.7 ± 0.4	200.6 ± 0.5	195.3 ± 0.4	0.000	225.1 ± 0.4	224.5 ± 0.4	219.3 ± 0.4	0.000
70–79	197.4 ± 0.7	196.5 ± 0.7	190.4 ± 0.6	0.000	221.1 ± 0.6	219.6 ± 0.6	213.9 ± 0.5	0.000

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; Glu, fasting blood glucose; T-CHO, total cholesterol. Statistically significant differences in BMI were identified with one-way analysis of variance. Statistically significant differences in SBP, DBP, Glu, and T-CHO were identified with analysis of covariance. A p value of 0.05 or less indicates statistical significance. [a] Mean ± standard deviation. [b] Mean ± standard error, adjusted for the possible influence of medication.

tant risk factors for stroke in Japan. Both the SMR for stroke and incidence of stroke were higher in *Nanyo* than in *Toyo* and *Chuyo*, and it is our view that there may be an association with high SBP, high DBP and low T-CHO. It is considered that regional differences in dietary habits may have led to higher SBP and DBP and lower T-CHO in *Nanyo*. In *Nanyo*, the percentages of subjects who consumed rice and fish (men and women), meat (men) and juice (women) daily were higher than in *Toyo* and *Chuyo*. High intakes of rice[16] and juice have been shown to lead to a higher rate of diabetes mellitus. Although there was no significant difference in the mean value for Glu between the three regions, it is well established that high Glu is also an important risk factor for stroke in Japan. An epidemiological study of fish consumption carried out by the Mayo Clinic suggested that T-CHO levels in subjects of towns with high fish consumption were lower than in towns where vegetables were the primary food[17]. Our results demonstrated that T-CHO levels were lowest in subjects in *Nanyo*, in spite of the fact that the percentage of men in *Nanyo* who eat meat daily was higher than in the other two regions. This can be attributed to the fact that the subjects of *Nanyo* also had high levels of fish consumption. The American Heart Association recommends the consumption of fish two or three times per week. We suggest the reason consumption of fish was higher in *Nanyo* than in the other two regions was that subjects of *Nanyo* still

maintain the traditional Japanese diet based on fish and rice (low in animal fat and high in carbohydrates). This diet is likely to be associated with low levels of T-CHO.

We need to address some limitations of this study. Our study design did not utilize a cohort protocol. Our protocol was a descriptive epidemiological study in which we were not able to clarify the direct relationship between incidence of stroke and risk factors. The survey asked about the consumption of only the following eight foods groups: rice, bread, eggs, fish, meat, vegetables, dairy products, and juice.

In conclusion, not only is the SMR for stroke higher in *Nanyo* than in the other two regions but so too is the incidence of stroke. One possible explanation is that in both men and women in *Nanyo*, the mean value for SBP and DBP is higher and the mean value for T-CHO is lower than in either *Toyo* or *Chuyo*. It is also conceivable that differences in dietary habits across the three regions may play a role.

Our future work is as follows: a cohort protocol study should be carried out on the 50,000 residents living in the model regions designated by the JA-EKCME in *Nanyo*. The study design should focus on establishing baseline data derived from (1) medical examination of residents, including follow-up of residents so as to record incidents of stroke (end point), and (2) a standard detailed questionnaire concerning food intake.

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