Trends in the Incidence of Stroke and Cardiovascular Risk Factors on the Isolated Island of Okinawa: The Miyakojima Study

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Background: Rapid deterioration of cardiovascular risk control, especially obesity, has occurred in Okinawa; this may affect cardiovascular disease incidence, including stroke. *Methods:* Cross-sectional field studies were conducted in 2 periods, 1988-1991 as the first period, and 2002-2005 as the second period, in the isolated island of Okinawa, Miyakojima. To evaluate population backgrounds related to cardiovascular risk factors, data from the health checkup programs conducted in 1987 and 2001 were surveyed. *Results:* Total of 257 patients in the first period and 370 in the second were diagnosed with first-time stroke. The age-adjusted annual incidence rate of first-time stroke of the first and second periods was 124 and 144 per 100,000 standard population of Japan. The age-adjusted annual incidence rate showed an upward trend for brain infarction (50 to 73) and downward trend for brain hemorrhage (61 to 54); however, those trends were not significant. The health checkup surveys illustrated that blood pressure decreased in all age groups during the second survey period. However, the body mass index increased in patients aged 50 years or more. Fasting blood glucose levels of patients aged 30-79 years and non-HDL cholesterol levels of patients aged 50-79 years significantly increased. *Conclusions:* In Miyakojima, the incidence of first-time stroke and all of its subtypes did not change significantly between two periods, even though blood pressure decreased significantly in the second period. Metabolic deterioration may be associated with the upward trend in incidence of brain infarction. **Key Words:** Incidence—obesity—metabolic syndrome and stroke—stroke epidemiology.

Introduction

Okinawa in Japan is home of the high centenarian population in the world. However, the abrupt lifestyle changes, such as a high-fat diet, have been widely adopted by younger generations during the last 30 years, resulting in the highest obesity rate of this area in Japan.[1] High obesity rates likely accompany metabolic deterioration, causing an increase in cardiovascular diseases. In Japan, the incidence of stroke is higher than that of coronary heart disease.[2-6] We previously conducted a large scale cross-sectional field study from 1988-1991 (COSMO study) and illustrated that the stroke incidence rate was similar to other areas in Japan.[4,5] In recent decades, there are publications regarding remarkable decline trend of stroke mortality[7,8] and stroke incidence[2,3,9] in Japanese population. To evaluate the trend from 1988-1991 to 2002-2005 in first-time stroke incidence in Okinawa, we conducted complete enumeration cross-sectional field studies in Miyakojima (Miyako Island), the third largest isolated island of the Okinawa prefecture.

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Methods

Study Population

The Okinawa prefecture is located in the extreme southwest of Japan and consists of 3 main and approximately 35 smaller inhabited islands and measures over 1,000-km long. Miyakojima is the third largest island of the Okinawa prefecture. The census population was 56,892 (27,751 men, 29,141 women, 22% aged 60 years and older) in 1990 and 55,587 (27,536 men, 28,051 women, 26% aged 60 years and older) in 2005. All Miyakojima residents were covered by the nationwide healthcare system under the control of the Ministry of Health and Welfare of Japan. All patients suffering from acute stroke initially visited an emergency room in a general hospital in Miyakojima for neurological evaluation and a brain CT and/or MRI diagnosis to determine stroke subtype. The CT equipment was installed in 1984 followed by the MRI equipment in 2001.

Stroke Patient Assignment

Stroke patient registration was performed in 2 periods: April 1, 1988–March 31, 1991 was defined as the first period (partial data from the COSMO study), and April 1, 2002–March 31, 2005 was defined as the second period. We visited 2 general hospitals in Miyakojima and reviewed the medical records of all patients diagnosed with stroke. Almost all symptomatic stroke patients visited these 2 hospitals to receive 24-h emergency service and/or a CT/MRI examination in Miyakojima. In this study, 98% of stroke patients in the first survey period and 99% for in second survey period were diagnosed by CT/MRI. Patients excluded from this study were younger than 30 years old, living outside Miyakojima, and those with recurrent stroke. Patient assignment was approved by the Institutional Ethics Committee, University of the Ryukyus.

Diagnosis of stroke subtype

First-time stroke patients classified into groups suffering from brain infarction (BI), brain hemorrhage (BH), or subarachnoid hemorrhage (SAH) using a previously employed protocol.[4] Additionally, BI patients from the second period were classified into 4 subtypes: atherothrombotic (AT), cardioembolic (CE), lacunar (LC), and stroke of undetermined etiology (UN). We implemented the combination protocol from the Trial of Org 10172 in Acute stroke Treatment (TOAST) criteria[10] and CT/MRI neuroimaging to assure accuracy of the final diagnosis.[11]

The Health Checkup Screening Program

The Okinawa General Health Maintenance Association (OGHMA)[12,13] is a nonprofit organization founded in 1972 and conducts a large, community-based health checkup annually throughout Okinawa where people reside or are employed. We reviewed data from previous OGHMA checkup surveys for citizens of 30 years and older in Miyakojima during 1987 (as first period; n = 12,205, 46% of census population, 30 years or older) and 2001 (as second period; n = 10,283, 34%) for cardiovascular risk factors: systolic and diastolic blood pressure (SBP, DBP), body mass index (BMI), total cholesterol (Tchol), HDL-cholesterol (HDL-C), non-HDL cholesterol (nHDL-C), and fasting blood glucose (FBG).

Statistical Analyses

Annual incidence rates by age-group were calculated with use of the census population of Miyakojima in 1990 for the first period, 2005 for the second period respectively. Age-adjusted annual incidence rates were determined by the direct method using the standard population derived from Japanese census figures in 1985.[4] The 95% CIs for the age-adjusted incidence rates were calculated using the method based on the Gamma distribution. Parameter comparison between subgroups was made using the Student's t-test, or one way ANOVA. The differences in age-adjusted incidence between first and second period were tested by the Cox proportional hazards model. A *P*-value of less than .05 was considered to be statistically significant. All analyses were performed using SAS software version 9.1 (SAS Institute Inc., Cary, NC, USA). Values are expressed as the mean ± standard deviation.

Results

Subtypes of First-time Stroke in Miyakojima

A total of 257 patients (51.4% men, 68 ± 14 year) from first period and 370 (53.2% men, 70 ± 14 year) from second were diagnosed with first-time stroke. The percentage of BI in all stroke subtypes increased (117/257, 46% to 201/370, 54%, $P = .04$) while BH decreased (123/257, 48% to 133/370, 36%, $P = .004$) between 2 observation periods (Table 1). Of 201 BI patients in second period, 65 patients (32%) were most commonly diagnosed with AT, 58 (29%) for LC, 51 (25%) for CE, and 27 (13%) for UN; however, sufficient data was not available for classification in first period.

Incidence of First-time Stroke in Miyakojima

The age-adjusted annual incidence rate of first-time stroke was 121 in the first period and 145 in the second period, per 100,000 using a standard population of Japan, without statistical significance (Table 1). In age-specific groups, the annual incidence rate of first-time stroke showed an upward trend in for age 50 years and older (Fig 1). In stroke subtypes, the age-adjusted annual incidence rate of BI showed an upward trend from 50 to 73, while the BH rate showed a downward trend from 61 to 54, respectively; however, those trends were not significant. SAH incidence was low (less than 30% of BI or BH in each period) and was not further analyzed (Fig 1).