Trends for Cardiovascular Risk Factors and Diseases in Japan

Takashi Shimamoto¹, Hiroyasu Iso¹, Takeshi Tanigawa¹, Tomoko Sankai¹, Hironori Imano¹, Tetsuya Ohira¹, and Satoru Miyake²

We presented trends of cardiovascular risk factors and diseases in a rural population, northeastern Japan between the 1960s and the 1990s. Population blood pressure levels declined substantially with improved medical treatment for hypertension and reduction of mean dietary sodium intake from 20g/day to 14g/day. Serum total cholesterol increased from 152mg/dl to 185mg/dl for men, and 163mg/dl to 195mg/dl for women with an increased intake of meat, egg, milk and dairy products. Age-adjusted incidence rate of stroke declined 75% while that of coronary heart disease was low and stable. The prevalence of stroke and the number of stroke patients also declined in spite of an increase of the elderly. Furthermore, the number of severely-disabled stroke patients, so-called bed-ridden patients decreased a half. The substantial decline in stroke incidence, prevalence along with the decline of blood pressure levels suggest an effect of population hypertension control program conducted since 1963. In nationwide, however, an increase in the prevalence of stroke patients and the number of severely disabled patients among the elderly were reported. Primary prevention of stroke through control and prevention of hypertension should be further augmented nationwide to reduce a public health burden from the disabled stroke patients in the elderly. J Epidemiol, 1996; 6: S183-S188.

Japan had the highest mortality from stroke and the lowest mortality from coronary heart disease among developed countries in 1960. The epidemic of stroke in Japan lead to launch population-based hypertension control programs in several communities, and contributed the development of stroke epidemiology. We have combined stroke prevention program and observational epidemiology for community residents and occupational populations, which is the best practical way to maintain long-term studies under the support of municipal governments and companies.

This article deals with trends in cardiovascular risk factors and diseases in a northeastern rural community between 1963 and 1991 to provide past and present pictures and future perspectives of cardiovascular disease in Japan.

METHODS

The surveyed communities were Ikawa, a rural rice-farming community, in Akita Prefecture, northeastern Japan with a total census 7,630 in 1965 and 6,294 in 1990. The method of blood pressure measurement has been reported previously. Four cross-sectional risk factor surveys were conducted for men and women aged 40-79 for the four-year periods of 1963-66, 1972-75, 1980-83 and 1987-91. The participation rates were consistently high for both men and women across the age groups: 64-88% for ages 40-49, 77-92% for ages 50-59, 79-94% for ages 60-69, and 55-74% for ages 70-79.

Systolic and fifth-phase diastolic blood pressures were measured by trained physician epidemiologists with a standard mercury sphygmomanometer in the right arm of participants, who seated quietly at least five minutes. Blood pressure measurement was repeated only when the first systolic measurement was >=140mmHg or diastolic measurement >=90 mmHg. The first measurement was used in data analysis. Hypertensives were defined as persons with systolic blood pressure >= 160mmHg and/or diastolic blood pressure >= 95

¹Institute of Community Medicine, University of Tsukuba, Tsukuba, Japan.
²The Ministry of Health and Welfare, Tokyo, Japan.
Address for correspondence: Takashi Shimamoto, Institute of Community Medicine, University of Tsukuba, Ibaraki-ken, 305 Japan.
mmHg and/or taking antihypertensive medication.

Blood was drawn from seated participants into a plain, silico-

dized glass tube and the serum was separated. Serum cho-

lesterol was measured by the Zak-Henly method in 1963-66,

and later by the Liebermann-Burchard direct method using the

Autoanalyzer II (Technicon, Tarrytown, U.S.A) at Osaka

Medical Center for Cancer and Cardiovascular Diseases4).

The laboratory has been standardized by the Lipid Stan-

ardization Program, Centers for Disease Control, Atlanta, and successfully

met the criteria of precision and accuracy of triglycerides

and cholesterol measurements4).

Height in stocking feet and weight in light clothing were

measured. Body mass index was calculated as weight divided

by the square of height (kg/m²). An interview was conducted to

ascertain the number of cigarettes smoked per day, usual weekly

take of ethanol in unit of go (a Japanese traditional unit of

volume corresponding to 23g ethanol), and use of diabetes

mellitus medications.

For nutrition assessment, a weighing method was used for

12 male volunteers aged 40-59 in 1969. After the 1970s, 24-
hour dietary recalls were conducted for men aged 40 and 59,

systematically sampled from the participants in risk factor sur-

veys. Comparability of these two surveys was discussed else-

where3), and trend in the percentage of fat intake to the total

calories was examined.

Stroke and coronary heart disease in men and women aged

>=30 were identified by reviewing all possible cases reported

from hospitals, national insurance claims, local physicians,

ambulance records, death certificates, public health nurses,

health volunteers, and blood pressure surveys. The complete-

ness of the combined case-finding sources was established at

the beginning of surveillance when a single, detailed house-

hold survey revealed no undetected cases3). To validate the

diagnoses, all living cases were visited to obtain a history from

cases and/or their families, and for stroke, systematic neuro-

logical examinations were conducted by study physicians.

Medical records of the local clinics and hospitals were

reviewed. For deaths, histories were obtained from families

and/or attending physicians and medical records were

reviewed.

Stroke was defined as a focal neurological disorder with

rapid onset which persisted 24 hours or more, based on

Millikan’s criteria5). Transient ischemic attack was not includ-

ed. Final standardized diagnoses of stroke were made by a

panel of three or four physician-epidemiologists, blinded to the

diagnoses of other panelists.

The criteria for coronary heart disease were modified from

those of a WHO Expert Committee6). Painless types of coro-

nary heart disease were not investigated because of difficulty

with complete ascertainment. 'Definite' myocardial infarction

was indicated by typical chest pain (lasting for 30 minutes or

longer) with the appearance of abnormal and persistent Q or

QS waves, or changes in cardiac enzyme activity or both.

'Suspect' myocardial infarction was indicated by typical chest

pain without positive electrocardiogram and enzyme activity

findings. Angina pectoris was defined as repeated episodes of

chest pain during effort, especially when walking, usually dis-

appearing rapidly after the cessation of effort or by use of sub-

lingual nitroglycerin. Final diagnoses were made by a panel

of three or four study physician-epidemiologists, blinded to the

data of the baseline examination. Definite or suspect myocar-

dial infarction, were combined and presented as myocardial

infarction. Five-year incidence rates were calculated as the

number of new cases per 1,000 census population.

Table 1. Mean values (SE) of systolic and diastolic blood pressure by sex and age in 1963-1966,1972-1975,1980-1983, and 1987-1991.

| Period       | Men (yr) |           | Women (yr) |           |
|--------------|----------|-----------|------------|-----------|
|              | 40-49    | 50-59     | 60-69      | 70-79     | 40-49     | 50-59     | 60-69     | 70-79     |
| Systolic blood pressure (mm Hg) | | | | | | | | |
| 1963-1966    | 142(1.4) | 150(1.8)  | 160(2.1)   | 169(3.6)  | 133(1.0)  | 142(1.4)  | 155(1.9)  | 165(3.6)  |
| 1972-1975    | 139(1.0) | 144(1.3)  | 156(1.8)   | 161(2.8)  | 130(0.8)  | 140(1.1)  | 151(1.5)  | 158(2.6)  |
| 1980-1983    | 131(1.0) | 136(1.1)  | 141(1.3)   | 147(2.3)  | 125(0.8)  | 132(0.8)  | 139(1.2)  | 147(1.9)  |
| 1987-1991    | 129(0.9) | 134(1.0)  | 137(1.1)   | 143(1.7)  | 126(0.8)  | 132(0.8)  | 136(0.9)  | 141(1.5)  |
| Diastolic blood pressure (mm Hg) | | | | | | | | |
| 1963-1966    | 85(0.9)  | 89(0.9)   | 89(1.0)    | 88(1.9)   | 79(0.6)   | 83(0.7)   | 87(0.9)   | 88(1.6)   |
| 1972-1975    | 86(0.7)  | 87(0.8)   | 87(0.9)    | 84(1.3)   | 80(0.5)   | 85(0.6)   | 85(0.7)   | 84(1.3)   |
| 1980-1983    | 83(0.7)  | 84(0.6)   | 83(0.7)    | 81(1.2)   | 77(0.5)   | 80(0.5)   | 80(0.6)   | 79(0.9)   |
| 1987-1991    | 83(0.6)  | 84(0.6)   | 82(0.6)    | 80(0.8)   | 78(0.6)   | 80(0.5)   | 79(0.5)   | 77(0.8)   |

Differences from the 1963-1966 values:* p< .05, +p< .01, ‡p< .001.
Table 2. The number of patients with hypertension and the percentage frequency of antihypertensive medication use by sex and age in 1963-1966, 1972-1975, 1980-1983, and 1987-1991.

| Period     | Men (yr) | Women (yr) |
|------------|----------|------------|
|            | 40-49    | 50-59      | 60-69 | 70-79 | 40-49 | 50-59 | 60-69 | 70-79 |
| Number of hypertensives | 1963-1966 | 77 | 112 | 111 | 32 | 49 | 110 | 105 | 43 |
| 1972-1975  | 109      | 110 | 132 | 59 | 60 | 116 | 129 | 64 |
| 1980-1983  | 69       | 125 | 108 | 66 | 47 | 118 | 127 | 90 |
| 1987-1991  | 52       | 106 | 114 | 84 | 33 | 108 | 139 | 80 |
| Antihypertensive medication use among hypertensives(%) | 1963-1966 | 14 | 21 | 15 | 6 | 22 | 21 | 19 | 21 |
| 1972-1975  | 29*      | 49‡ | 61‡ | 76‡ | 42 | 45‡ | 70‡ | 69‡ |
| 1980-1983  | 55‡      | 67‡ | 82‡ | 86‡ | 72‡ | 82‡ | 84‡ | 88‡ |
| 1987-1991  | 40‡      | 60‡ | 80‡ | 80‡ | 52* | 72‡ | 83‡ | 88‡ |
| Antihypertensive medication use among the participants(%) | 1963-1966 | 4 | 8 | 9 | 4 | 3 | 6 | 9 | 12 |
| 1972-1975  | 9*       | 23‡ | 36‡ | 50‡ | 5 | 14‡ | 35‡ | 49‡ |
| 1980-1983  | 13‡      | 26‡ | 41‡ | 54‡ | 9‡ | 24‡ | 36‡ | 56‡ |
| 1987-1991  | 8‡       | 18‡ | 35‡ | 46‡ | 5 | 17‡ | 32‡ | 46‡ |

Differences from the 1963-1966 values: * p< .05, +p< .01, *p< .001.

RESULTS

Figure 1 illustrated changes in lifestyles in Ikawa between the 1960s and the 1980s. Mean intake of meat was extremely low in the 1960s and increased double in the 1980s. Consumption of egg, milk and other dairy foods also increased. Mean intake of total fat (% of total calories) increased from 12% in the 1960s to 17% in the 1980s, with the doubled animal fat intake. Mean salt intake declined from 20 g/day to 14g/day. Working conditions in farming and other

Table 3. The prevalence of normotension according to past or present antihypertensive medication use by sex and age in 1963-1966, 1972-1975, 1980-1983, and 1987-1991.

| Period     | Men (yr) | Women (yr) |
|------------|----------|------------|
|            | 40-49    | 50-59      | 60-69 | 70-79 | 40-49 | 50-59 | 60-69 | 70-79 |
| Normotension with medication among the participants(%) | 1963-1966 | 1 | 1 | 4 | 2 | 2 | 5 | 2 | 3 |
| 1972-1975  | 3        | 5* | 5 | 6 | 5* | 7‡ | 8 | 6 |
| 1980-1983  | 6*       | 12‡ | 13* | 14* | 9‡ | 12‡ | 20‡ | 19‡ |
| 1987-1991  | 4        | 7‡ | 19‡ | 20† | 5* | 13‡ | 20‡ | 23‡ |
| Normotension without medication among the participants(%) | 1963-1966 | 47 | 37 | 20 | 9 | 65 | 45 | 31 | 20 |
| 1972-1975  | 49       | 33 | 19 | 11 | 68 | 43 | 27 | 10 |
| 1980-1983  | 61‡      | 44 | 33* | 20 | 75† | 55* | 39 | 22 |
| 1987-1991  | 65‡      | 54‡ | 37‡ | 27* | 78‡ | 59‡ | 45‡ | 27 |

Differences from the 1963-1966 values:* p< .05, †p< .01, ‡p< .001.
Table 4. Mean values (SE) of systolic and diastolic blood pressures between offspring and parents aged 40-49.

|          | Men |          | Women |          |
|----------|-----|----------|-------|----------|
|          | Offspring | Parents | Offspring | Parents |
|          | 41 pairs |         | 25 pairs |         |
| Systolic blood pressure (mm Hg) | 134(2.7)* | 154(3.0) | 120(2.3)* | 132(4.5) |
| Diastolic blood pressure (mm Hg) | 85(1.9)* | 92(1.8) | 73(1.9)* | 82(2.8) |

Differences from parents' values: * p< .05, + p< .01.

manual work changed substantially by the wide use of machines, leading the reduction of physical activities.

Mean systolic and diastolic blood pressures declined in all age groups of both men and women between the 1960s and the 1990s (Table 1). The blood pressure decline was larger in ages 60-79 than in the younger ages for both sexes. Distributions of systolic blood pressure for men and women aged 60-69 were shown in Figure 2. The prevalence of high systolic blood pressure (≥ 200mmHg) declined first between the 1960s and the 1970s. Between the 1970s and the 1980s, the distribution shifted downward with a large decrease in the prevalence of systolic blood pressure ≥ 160mmHg. After the 1980s, there was no further shift of the distribution, but the prevalence of systolic blood pressure of 150-169 mmHg decreased. A similar trend was seen for other age groups and for diastolic blood pressure.

The frequency of medication use among hypertensives was 6% to 22% in all sex-age groups in the 1960s, and increased in a stepwise fashion between the 1960s and the 1980s, reaching saturation towards the 1990s (Table 2). The frequency of medication use among all participants was 12% or less in the 1960s and increased similarly.

The prevalence of normotensives with past or present medication use increased in all sex-age groups between the 1960s and the 1980s, reaching saturation for men aged 40-59 and for women aged 40-69 (Table 3). The proportion of normotensives without antihypertensive medication use showed no change between the 1960s and the 1970s, but it did increase for all sex-age groups thereafter.

Blood pressure levels for participants and their offspring when both of parents and offspring were aged 40-49 were available because of long-term risk factor surveys. If either parents or offspring used antihypertensive medication, the parent-offspring pair was excluded from the analysis. Mean values of systolic and diastolic blood pressure were significantly lower in offspring than in parents for men and women (Table 4).

There was a significant rise in mean serum cholesterol in every age-sex group between the 1960s and the 1990s. Approximately 30 mg/dl rise was found for both men and women (Table 5).

Stroke incidence in ages 40-69 declined over 78% for men and 70% between the 1960s and the 1990s (Figure 3). The decline was larger for cerebral hemorrhage than for cerebral infarction. For ages 70 and over, stroke incidence did not decline until the end of the 1970s, but decreased thereafter. A similar trend was seen for cerebral infarction, and a consistent

Table 5. Mean values (SE) of serum total cholesterol by sex and age in 1963-1966, 1972-1975, 1980-1983, and 1987-1991. (mg/dl)

| Period       | Men (yr) |          | Women (yr) |          |
|--------------|----------|----------|------------|----------|
|              | 40-49    | 50-59    | 60-69      | 40-49    | 50-59    | 60-69      |
| 1963-1966    | 156(1.8) | 158(1.5) | 156(2.1)   | 155(1.3) | 167(1.7) | 166(2.0)   |
| 1972-1975    | 175(1.8)*| 178(1.9)*| 173(2.2)*  | 175(1.4)*| 190(1.7)*| 191(2.0)*  |
| 1980-1983    | 181(2.0)*| 180(1.7)*| 176(2.0)*  | 181(1.8)*| 196(1.6)*| 200(1.8)*  |
| 1987-1991    | 188(2.0)*| 187(1.7)*| 182(1.9)*  | 187(1.7)*| 202(1.8)*| 202(1.7)*  |

Differences from the 1963-1966 values: * p< .001.
A substantial decline in stroke incidence was attributable to a large decline in blood pressure levels for both men and women of ages 40-79.

The decline in blood pressure levels between the 1960s and the 1970s was mostly due to an improvement of detection and treatment of hypertension. The larger blood pressure decline with a shift of the whole blood pressure distributions between the 1970s and the 1980s were difficult to be attributable solely to the increase of antihypertensive medication use, because there was an increase in the frequency of normotensives without med-
The successful decline in the stroke incidence and prevalence in the rural community warrants the importance of a long-term hypertension control and prevention in the community. In nationwide, however, an increase in the prevalence of stroke patients and the number of severely disabled patients in the elderly were reported. Primary prevention of stroke through control and prevention of hypertension should be further augmented to reduce public health burden from the disabled stroke patients in the elderly.

REFERENCES

1. Health and Welfare Association. Trends in national hygiene. Kosei no Shihyo 1994;41 (suppl):402-403 (in Japanese).
2. Komachi Y, Iida M, Shimamoto T, et al. Geographic and occupational comparisons of risk factors in cardiovascular diseases in Japan. Jpn Cir J 1971;35:189-207.
3. Shimamoto T, Komachi Y, Inada H, et al. Trends for coronary heart disease and stroke and their risk factors in Japan. Circulation 1989;79:503-515.
4. Nakamura M, Morita M, Yabuuchi E, et al. The evaluation and the results of cooperative cholesterol and triglyceride standardization program by WHO-CDC. Rinsho Byori 1982;30:325-332 (in Japanese).
5. Millikan CH. A report by an ad hoc committee established by the Advisory Council for the National Institute of Neurological Disease and Blindness, Public Health Service. A classification and outline of cerebrovascular diseases. Neurology 1958;8:393-433.
6. Rose GA, Blackburn H. Cardiovascular survey methods. Geneva, World Health Organization 1968.
7. Komachi Y. Prevention of cardiovascular disease, a public health strategy for stroke epidemic. Tokyo, Suma Press 1978:133-150 (in Japanese).
8. Shimamoto T, Nakanishi N, Komachi Y, et al. Blood Pressure Levels in Parents and their Offspring - A 20-year Observational Study. Jpn J Public Health 1989;36(3):161-169 (Engl Abst).
9. Nutrition Division, Public Health Bureau, Ministry of Health and Welfare. Kokumin Eiyo No Genjyo (The National Nutrition Survey, 1990). Tokyo: Daichi Shuppan, 1992 (in Japanese).
10. Konishi M, Iida M, Naito Y, et al. The trend of coronary heart disease and its risk factors based on epidemiological investigations. Jpn Cir J 1987;51:319-324.
11. Komachi Y. Future Aspect of Community Health (Chiikihoken no Shoraizo). Jpn J Public Health 1990;37(5):365-373 (in Japanese).