Lifetime Risk of Stroke in Japan

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Background and Purpose—Lifetime risk (LTR) is an epidemiologic measure that expresses the probability of disease in the remaining lifetime for an index age. The LTR for stroke has not been reported for the Japanese population.

Methods—We included all participants from the Suita Study who were cardiovascular disease–free at baseline. Age (in years) was used as the time scale. Age-specific stroke incidence and all-cause mortality were calculated with the person-year method, and we estimated the sex- and index age–specific LTRs of first-ever stroke and its subtypes, taking into account the competing risk of death.

Results—We followed up 5498 participants from 1989 to 2005 for a total of 67,475 person-years. At age 55 years, the LTR for stroke, after accounting for competing risks of death, was 18.3% for men and 19.6% for women. The LTR for cerebral infarction was 14.6% for men and 15.5% for women, and the LTR for intracerebral hemorrhage was 2.4% for men and 1.4% for women at the index age of 55 years. The LTR for stroke remained similar across other index ages of 45, 55, and 65 years.

Conclusions—The observed probabilities illustrate that ≈1 in 5 men and women of middle age will experience stroke in their remaining lifetime. This easy understandable information can be used as an important index to assist in public health education and planning. (Stroke. 2010;41:1552-1554.)

Key Words: lifetime risk ■ stroke ■ Japan

Despite decades of declining mortality from stroke since the 1960s,1,2 stroke remains the third most common cause of death in Japan.3 With the aging of the population and an unfavorable cardiovascular risk factor scenario, stroke is likely to become an increasingly important health burden in Japan. Thus, prevention activities for stroke require urgent attention.

Estimation of the lifetime risk (LTR) of stroke, which provides an absolute risk assessment and would be more easily understood by the general population, can be useful in public health education. This index has the potential to promote early detection efforts, increase awareness, and motivate beneficial changes in lifestyle or health behaviors. The LTR of stroke has not yet been reported for the Japanese population. In the present study, we estimated the short- intermediate-term risk and LTR of stroke and its subtypes in Japanese.

Subjects and Methods

Study Sample

The Suita Study, a cohort study of cardiovascular disease established in 1989, randomly sampled Suita city residents, age 30 to 79 years, by sex and age class (10-year increments).4 From this sample, 6485 participated in the baseline survey (participation rate, 53%) at the National Cardiovascular Center in Osaka. After we excluded participants with a past history of cardiovascular disease (n = 208) and those who did not participate in the baseline survey or were lost to follow-up (n = 779), data for the remaining 5498 participants (2571 men and 2927 women) were included in this analysis. Follow-up for the current study ended at the time of stroke occurrence, at death, or on December 31, 2005, whichever came first.

Identifying possible stroke events involved checking the health status of all participants by repeated clinical visits every 2 years and yearly questionnaires by mail or telephone. All hospitalizations and deaths during the previous year were identified. To complete our surveillance for fatal events, we conducted a systematic search of death certificates for Suita City residents by accessing the National Vital Statistics database, with the permission from the Management and Coordination Agency of Japan. The underlying causes of death in the National Vital Statistics were coded according to the 9th International Classification of Diseases by the end of 1994 and the 10th International Classification of Diseases from the beginning of 1995. All data (health check-ups, questionnaires, telephone queries, and death certificates) were checked against medical records to confirm the incidence of stroke. In-hospital medical records of participants who were suspected of having had a stroke were reviewed by registered hospital physicians or research physicians, who were blinded to the baseline information. Using criteria adopted from the US National Survey of Stroke,5 we defined a stroke event as a sudden or rapid onset of neurologic symptoms lasting for >24 hours or leading to death, in the absence of evidence of a nonstroke cause. Strokes were classified as cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage, based on computed tomography, magnetic resonance imaging, or autopsy findings. This study was approved by the institutional review board of the National Cardiovascular Center.

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Statistical Analysis

The residual LTR has been defined in 2 ways in the literature: (1) lifetime cumulative incidence that indicates the cumulative risk for the remaining lifetime but does not account for the impact of mortality due to competing causes and (2) lifetime cumulative incidence that accounts for competing risk of death. We estimated both statistics in our study.

The incidence rate of stroke and all-cause mortality rate were estimated in 5-years age increments by the person-year method. The probability of developing stroke was computed by applying these age-specific incidence and mortality rates. The number of individuals at risk for stroke at age \( t \), \( N_t \), and the number of incident cases at age \( t \), \( n_t \), were calculated with the following formulas:

\[
N_{t+1} = N_t \times (1 - m_t - r_t)
\]
\[
n_{t+1} = n_t \times N_{t+1}
\]

where \( N_t \) is the number of individuals at risk at the index age \( t \); \( m_t \) is all-cause mortality at age \( t \); and \( r_t \) and \( r_{t+1} \) are the incidences of the event at ages \( t \) and \( t+1 \), respectively.

The numerator of LTR (expressed in percent) was the total number of incident cases that accumulated after the specified index age, and the denominator of LTR was the number of individuals at risk at the index age. LTR estimates were extended to 95 years of age because few participants survived past 94 years. The numerator of LTR for index age \( i \) was determined with the following formula:

\[
LTR_i = \frac{\sum_{t=i}^{94} n_t}{N_i}
\]

We estimated sex-specific 10-, 20-, 30-, and 40-year risks and the LTR at different index ages for stroke and its subtypes. All statistical analyses were performed with SAS version 9.1 (SAS Institute, Cary, NC).

Results

We had 67 475 person-years of observation. The incidence rate was 392.8 per 100 000 person-years for men and 253.6 per 100 000 person-years for women. The incidence rate was 239.8 per 100 000 person-years for cerebral infarction, 103.7 per 100 000 person-years for cerebral hemorrhage, and 52.7 per 100 000 person-years for subarachnoid hemorrhage.


<table>
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<th>Stroke Type</th>
<th>Sex</th>
<th>Index Age, y</th>
<th>10-Year Risk</th>
<th>20-Year Risk</th>
<th>30-Year Risk</th>
<th>40-Year Risk</th>
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<td>19.14</td>
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<td>65</td>
<td>8.79</td>
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All risk values are expressed as percentages. To account for the competing risk of death on the probability of stroke; we estimated LTR conditional on survival to an index age, by executing a multiple-decrement procedure and taking into consideration both the occurrence of an event and death from any cause.
The Table presents the 10-, 20-, 30-, and 40-year risks and LTR for all stroke and stroke subtypes in men and women who reached various index ages. Accounting for competing risks of death attenuated the estimates of the cumulative incidence for stroke to some extent for all index ages and for both sexes. There was a graded increase in stroke risk with increasing time span. For all strokes, the 10-year risk at age 45 was 0.7%, and this increased for the 20-, 30-, and 40-year risk categories to 3.2%, 7.9%, and 14.4%, respectively. This phenomenon was observed in both sexes and for all stroke subtypes. With regard to stroke subtype, the LTR of ischemic stroke was higher than that for hemorrhagic stroke. This was observed in both men and women and at all index ages.

Discussion

To the best of our knowledge, this is the first report to present the LTR of stroke in any non-Western population. The LTR of stroke in our study is similar to the reported LTR in the Framingham8 or Rotterdam9 study. The LTRs of stroke for middle-aged adults were substantial. The observed probabilities illustrate that ≈1 in 5 men and women of middle age will experience stroke. This risk was higher for cerebral infarction (for men, 1 in 7 and for women, 1 in 6) than for cerebral hemorrhage (for men, 1 in 40 and for women, 1 in 60) or subarachnoid hemorrhage (for men, 1 in 200 and for women, 1 in 50). The LTR was similar for the index ages of 45, 55, and 65 years.

The strengths of our study include the use of a population-based cohort and the fact that our estimates were based on simultaneously gathered data on both stroke incidence and other-cause mortality attributable to the competing risk of death in the same cohort. The incidence of stroke and its subtypes in our study population is similar to that in other population-based or cohort studies in Japan.10,11 During recent decades in Japan, ischemic stroke has been reported to be the dominant subtype as a proportion of all strokes, being 3 to 4 times more frequent than cerebral hemorrhage,10,11 which is similar to our findings.

Our LTR estimates are useful for public education because they are easier to comprehend than are measures such as incidence, prevalence, or relative risk.12 LTR is a more generalizable approach to health education because it avoids the common problems associated with complicated numeracy or low quantitative literacy.13 A recent study with focus group discussions has concluded that patients preferred health risks to be framed in absolute terms and a lifetime estimate on a scale of “x out of 100.”14 In particular, the interpretation with the reciprocal number of probability estimated in our study, for example, that 1 in 5 men of 45 years will have a stroke during their lifetime, presents the risk of stroke in an intuitively comprehensible form.

In Japan, it has been reported that the incidence of stroke has declined over time, but recent evidence suggests that the incidence might have leveled off during the last few decades.15 With stroke incidence being stagnant and the LTR estimates presented herein that 1 in 5 of middle-age and older adults is likely to develop stroke during their remaining lifetime, our results emphasize that stroke poses a major threat as a public health burden. In younger individuals with low short-term risks, the high LTR might be more useful to motivate lifestyle modifications, with appropriate health education efforts aimed at prevention of stroke, thereby reducing the population burden of stroke.

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Disclosures

None.

References

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