Data Report

Lifetime Risk of Acute Myocardial Infarction in Japan

Tanvir Chowdhury Turin, MBBS; Yoshihiro Kokubo, MD; Yoshitaka Murakami, PhD; Aya Higashiyama, MD; Nahid Rumana, MBBS; Makoto Watanabe, MD; Tomonori Okamura, MD

The incidence and mortality from coronary heart disease (CHD) in Japan are reported to be among the lowest of all industrialized countries,1,2 but, in the backdrop of major dietary changes and worsening cardiovascular risk factors,2 recent reports have shown an increasing trend of acute myocardial infarction (AMI) in the Japanese population.3,4 With the aging of the population and the presence of unfavorable cardiovascular risk factor scenario, AMI is likely to be an increasingly important health burden in Japan. Thus, prevention of AMI requires urgent attention.

Lifetime risk (LTR) is an epidemiological measure that expresses the probability of disease in the remaining lifetime for an index age. Estimation of the LTR of AMI, which provides an absolute risk assessment, has not yet been reported for the Japanese population. In the present study, we estimated the short- and intermediate-term risks and LTR of AMI in a Japanese population.

Study Population

The Suita study,5 a cohort study for cardiovascular disease (CVD) established in 1989, randomly sampled Suita city residents ages 30 to 79 years and stratified the residents by sex and age class (10-year increments). From this sample, 6485 participated in the baseline survey between 1989 and 1994 (participation rate, 53.2%) at the National Cerebral and Cardiovascular Center, Osaka. After excluding participants with a history of CVD (n=208) and those lost to follow-up (n=779; predominantly because of moving out of Suita city after consenting to participate in the study, but before partaking in the baseline survey), data from the remaining 5498 participants (2571 men and 2927 women) were included in the analysis. The follow-up for the present study ended either at (1) AMI occurrence, (2) death, (3) date of leaving Suita city, or (4) at December 31, 2005, whichever came first. Identifying possible AMI events involved checking the health status of all participants by clinic visits every 2 years and yearly questionnaires administered by mail or telephone. For participants who were suspected of having an AMI based on clinic visits or questionnaires, the available medical records were reviewed by research physicians or registered hospital physicians for event ascertainment. The AMI diagnostic criteria used in this study were in accordance with the criteria of the WHO-MONICA (Monitoring Trends and Determinants of Cardiovascular Disease) project.6 All suspected AMI cases in the population during the study period were identified and evaluated on the basis of information from medical history, clinical symptoms, ECG, and serum levels of cardiac enzymes. Using the diagnostic algorithm adapted from the WHO-MONICA study, the eligible registered cases were classified into 1 of the following categories: “definite AMI,” or “possible AMI.” To complete our surveillance for fatal events, we conducted a systematic search for death certificates of Suita City residents using the National Vital Statistics to identify the underlying causes of deaths. Details of the study participants, baseline examinations, case ascertainment and diagnostic criteria, analysis sample, and end point determination are provided in the online supplement. This study was approved by the Institutional Review Board of the National Cerebral and Cardiovascular Center.

LTR Estimation

The residual LTR is the cumulative absolute incidence that indicates the cumulative risk of an event over the remaining lifetime.7 The remaining lifetime can be based on the duration of survival of the study participants or the life expectancy of the general population. The risk can also be affected by the competing risk of mortality, which attenuates the actual cumulative risk of the event. Therefore, in this analysis, we estimated the LTR of AMI, taking into consideration the competing risk of death.

The incidence rate of AMI and all-cause mortality rate were estimated from our study population for each 5-year age group by person-year method.8 Age (in years) was used as the time scale. These incidence rates and mortality rates were used in the LTR calculation process. The probability of developing AMI was computed by applying the aforementioned age-specific incidence and mortality rates that we determined for our study population, to a hypothetical cohort of arbitrary starting value of \( N_0 \), the number of individuals at risk at the index age \( t \). This hypothetical cohort is considered...
at risk for 2 mutually exclusive events: (1) first-time AMI and 
(2) death from other causes. Thus, we derived a multiple 
decrement life-table using these 2 events. The number of 
individuals at risk at age $t$, $N_t$, and number of incidence 
cases at age $t$, $n_t$, was expressed in the following 
formulas:

$$N_{t+1} = N_t \times (1 - m_t - r_t)$$

$$n_{t+1} = r_{t+1} \times N_{t+1}$$

where $N_t$ is the number of individuals at risk at the index age 
t; $m_t$ is the probability of all-cause mortality at age $t$; and $r_t$ 
and $r_{t+1}$ are the incidence of event at age $t$ and $t+1$, 
respectively.

The numerator of LTR (expressed in percent) was the total 
number of incidence cases that accumulated after the speci-
fied index age. The denominator of LTR was the number of 
individuals at risk at the index age. In our analysis, we 
decided to terminate the iterative process when the age of the 
population at risk reached 95 years. The numerator of LTR 
for index age $i$ was expressed in the following formula:

$$\sum_{t=i}^{94} n_t$$

The LTR for index age $i$ (with population at risk at age $i$ as 
$N_i$) was estimated as

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

We estimated sex-specific 10-, 20-, 30-, and 40-year risks and 
the LTR at different index ages for AMI.

**LTR of AMI**

The mean age for men was 55.8 years (SD, 13.2), and for 
women was 54.2 years (SD, 12.8). Among men, 37% were 
hypertensive, 6.4% were diabetic, 28.3% had hypercholester-
olemia, 46.5% were current smokers, and 72% were current 
drinkers. Among women, 34.1% were hypertensive, 4.3% 
were diabetic, 41.8% had hypercholesterolemia, 12% were 
current smokers, and 30% were current drinkers.

There were 67,475 person-years of observation. During the 
follow-up period, 124 (83 men and 41 women) participants 
had incident AMI. The incidence rates of AMI were 269.5 per 
105 person-years for men and 111.8 per 105 person-years for 
women during the follow-up period. Age-specific incidence 
rates for myocardial infarction from the Suita study and the 
cumulative incidence for AMI to 95 years of age accounted 
for competing risk of death according to different age at entry 
into the study are provided in the online supplement.

The Table presents the 10-, 20-, 30-, and 40-year risks and 
LTR of AMI in men and women who reached various index 
ages. The LTR of AMI for men at 45 years of age, adjusted 
for competing risk of death, was 16.2%. The LTR adjusted 
for competing risk of death for women at 45 years age was 
11.6%. There was a graded increase in AMI risk with 
increasing time span. For men, the 10-year risk of AMI at the 
age of 45 was 1.0%, and this increased across 20-year, 
30-year, and 40-year risk categories as 2.8%, 5.0%, and 9.5%, 
respectively. This phenomenon was observed in both sexes.

### Table. Age- and Sex-Specific 10-, 20-, 30-, and 40-Year and Lifetime Risk Estimates for Myocardial Infarction: The 
Suita Study, 17-Year Follow-Up, 1989 to 2005, Japan

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<th>Index Age, y</th>
<th>AMI Incidence</th>
<th>All-Cause Mortality</th>
<th>10-Year</th>
<th>20-Year</th>
<th>30-Year</th>
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<td>43.4</td>
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Discussion

To the best of our knowledge, this is the first report to present the LTR of AMI in any non-Western population. The LTR of developing CHD was reported to be 46.9% (approximately 1 in 2) for men and 31.1% (approximately 1 in 3) for women at the age of 50 years in the Framingham study, and the LTR in men was 34.5% (approximately 1 in 3) in the Physicians’ Health study. However, our estimate shows that at the age of 50 years, the LTR of developing AMI in Japan is much lower: 16.1% for men and 11.6% for women. The observed probabilities illustrated that approximately 1 in 6 men and 1 in 9 women of middle age in Suita, Japan, will have an AMI in their remaining lifetime. The LTR was similar for the index ages of 50, 60, and 70 years. The lack of increase in lifetime risk with increasing age is consistent with other reports.

The strength of this study is that our estimates are based on simultaneously gathered data on both AMI incidence and other causes of mortality attributable to competing death risk in the same community-based cohort. Thus, we were able to adjust the LTR for the competing risk of death. Our cohort was based on a predominantly urban population, and the incidence of AMI in our population is higher than that in other reports from Japan. Thus, generalization of our findings to the broader Japanese population warrants caution. Estimation of the LTR of AMI from other historic cohorts in Japan should be initiated. We estimated the LTR of AMI at selected index ages, which did not account for the unique prevalence of risk factors as well as subsequent temporal trends of risk factor prevalence and control. The follow-up period occurred during an era of marked adoption of statin therapy, increased emphasis on smoking cessation, and improved blood pressure control, which could modify the LTR of AMI. Additionally, the loss of 12% (779/6485) of baseline participants from follow-up in the Suita study could have influenced the study results to some extent. Given the increase in AMI incidence in Japan over the past 2 decades, the LTR in our study might be underestimated. However, because the reported increases in AMI incidence over the past 2 decades are not large, the influence on the LTR should not be substantial. In addition, LTR estimates represent average values at the population level. In individuals, the risk would vary according to each individual’s risk factor profile. Thus, the LTR estimations should be interpreted with caution when translating them to risk in individuals. However, these indexes represent an important addition to understanding risks at the population level. Besides, these LTR estimates might be useful for public education because they are easier to comprehend than measures such as incidence, prevalence, or relative risk. Furthermore, LTR data may be compared between different diseases to allow appropriate allocation of resources for the prevention and management of competing causes of morbidity and mortality.

Sources of Funding

This study was supported by Intramural Research Fund of National Cerebral and Cardiovascular Center (22-4-5). Drs Turin and Rumana are supported by fellowships and research grants-in-aid (P-20.08124 and P-21.09139) from the Japan Society for the Promotion of Science.

Disclosures

None.

References


Key Words: lifetime risk ■ acute myocardial infarction ■ Japan ■ epidemiology ■ population
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Circ Cardiovasc Qual Outcomes. 2010;3:701-703
doi: 10.1161/CIRCOUTCOMES.109.930776
Circulation: Cardiovascular Quality and Outcomes is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 1941-7705. Online ISSN: 1941-7713

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