

Supplementary contents 2

Methods of calculating SMR

Calculating SMR is one of the methods of indirect standardization. The SMR compares total number of deaths in the study population (=D) to expected number of deaths (=E) calculated by applying the mortality rate of the general population to the age distribution of the study population. Observed and expected number of deaths were calculated in each age-strata × period-strata.[Ref 1] The SMR for the study population was calculated as follows:

$$SMR = \frac{\sum_{i,j} d_{ij}}{\sum_{i,j} n_{ij} \mu_{ij}} = \frac{\sum_{i,j} d_{ij}}{\sum_{i,j} e_{ij}} = \frac{D}{E}$$

where

d_{ij}: number of deaths in the unit of *i*th age group and *j*th period group in the study population

n_{ij}: total person years in the unit of *i*th age group and *j*th period group for the study population

μ_{ij}: mortality rate of *i*th age group and *j*th period group for the Japanese general population

e_{ij}: expected number of deaths in the unit of *i*th age group and *j*th period group in the study population

D: observed number of deaths in the study population

E: expected number of deaths

The age grouping consisted of 5-year intervals from the ages of 0-4 up to 90-94. The period grouping consisted of 1-year intervals from 1952 to 2017. Mortality rates of the Japanese general population for 1950, 1955, 1960, ... , 2005, 2010 and 2015 were obtained from Japanese demographic statistics and used as mid-year rates for 5-year intervals from 1948-1952 up to 2012-2017.

Observed and expected number of deaths in the study population were then categorized according to observation period (1952-1997, 1998-2007, 2008-2017) and years from last participation (0-<10, 10-<20, 20-<30, and 30 years), and SMR was calculated for each category.

The lexis diagram is a two-dimensional diagram that describes events belonging to different birth cohorts.[Ref 1,2] The Lexis diagram for the study population is described in page 3. The vertical axis

represents age, and the horizontal axis represents calendar time. Each straight line, called “life line”, represents each Olympian’s life. Each life line starts at the last participation date. For an Olympian whose vital status is “dead”, the life line ends at the date of death. Each red dot represents each Olympian’s death. For an Olympian whose vital status is “alive”, the life line ends at the earlier date of the latest follow-up date or 31 December 2017.

References for this supplementary content

1. Breslow, N.E. & Day, N.E. (1987) *Statistical Methods in Cancer Research, Vol II, The Design and Analysis of Cohort Studies* (IARC Scientific Publications No.82), Lyon, International Agency for Research on Cancer.
2. B. Carstensen. Age-period-cohort models for the Lexis diagram. *Statist. Med* 2007; 26:3018–3045.

