Standardized mortality ratio (SMR)

Statistical concepts for clinical investigators
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November 7, 2014

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In this example:
Molyneux AJ, Kerr RS, Birks J, Ramzi N, Yarnold J, Sneade M, Rischmiller J; ISAT Collaborators. **Risk of recurrent subarachnoid haemorrhage, death, or dependence and standardised mortality ratios after clipping or coiling of an intracranial aneurysm in the International Subarachnoid Aneurysm Trial (ISAT): long-term follow-up.** Lancet Neurol. 2009 May;8(5):427-33. doi: 10.1016/S1474-4422(09)70080-8.

the investigators calculated the SMR to assess whether patients who survive for at least a year following intracranial aneurysm nevertheless have a higher overall risk of death than the general population.

The SMR compares, in a ratio,

the number of deaths *observed* among patients in a sample

to the number of deaths *expected* in the general population if its distribution of, for example, age and gender reflects that of patients in the study sample.

The investigators classified observed death by the patient's sex, the year during which the patient died (between 1998 and 2007), and the patient's age at death.

Vital statistics from England and Wales provided year-, sex- and age-specific death rates. "The expected number of deaths was calculated for each year and summed over all years." In the Table, I have inserted simulated but plausible numbers to illustrate how "standardization" arrives at an expected number of deaths in a given year.

Table. Number of deaths observed among study patients in 2004, compared with deaths expected on basis of that year's death rates (fabricated for this example), by sex, in England and Wales

	Males				Females			
Age*	**(1) Patients alive on 1-1-2004**	**(2) Observed deaths during 2004**	**(3) Age-and sex-specific death rate in population**	**(4) Expected number of deaths in 2004 [(1)*(3)]**	**(1) Patients alive on 1-1-2004**	**(2) Observed deaths during 2004**	**(3) Age-and sex-specific death rate in population**	**(4) Expected number of deaths in 2004 [(1)*(3)]**
35-44	10	0	.0001	0.001	20	0	.0001	0.002
45-54	150	2	.005	0.75	300	3	.004	1.2
55-64	200	4	.008	1.6	400	6	.006	2.4
65-74	120	3	.010	1.2	240	3	.009	2.16
75-84	25	2	.014	0.35	50	3	.012	0.6
85+	10	0	.020	0.2	20	0	.018	0.36
Total		**11**		**4.1**		**13**		**6.72**

*"The age of each patient [at death] was assessed as though at midpoint of each year."

In this simulated example, the SMR for 2004 = observed deaths / expected deaths = (11+13)/(4.10+6.72) = 2.22.

In observing 144 deaths, while expecting 92 deaths among an age- and sex-matched portion of the general population of England and Wales, the investigators concluded that survivors of ICH have an elevated risk of mortality (SMR=1.57; (95%CI: 1.32 , 1.82).