Standardization of Rates

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Outlines

Introduction
Direct Standardization
Indirect Standardization

Introduction

Crude rate

$$\text{Crude death rate} = \frac{\text{Death}}{\text{Total}}$$

$$R = \frac{D}{N}$$

- Simple, but does not take into account the composition of population → subgroups or strata.
- Comparing crude rates of different populations may not be accurate if they differ in composition.
- Unable to compare crude mortality rate of Somalia to Japan directly:

Country	Somalia	Japan
Mortality rate (/1,000 population)	14.55 deaths	9.15 deaths
Age structure	0-14 years: 44.5% 15-64 years: 53.1% ≥ 65 years: 2.4%	0-14 years: 13.5% 15-64 years: 62.6% ≥ 65 years: 23.9%
Total population	10,085,638	127,368,088

* CIA World Factbook 2012

- Note the countries have totally different age structure.

Standardization of rate

- Enables comparison across different populations by selecting a standard population to make comparison.
- The standard population serves as a weight or mediator of comparison, let say we choose Malaysia:

Country	Somalia	Japan	Malaysia
Mortality rate (/1,000 population)	14.55 deaths	9.15 deaths	4.95 deaths
Age structure	0-14 years: 44.5% 15-64 years: 53.1% $\geq$ 65 years: 2.4%	0-14 years: 13.5% 15-64 years: 62.6% $\geq$ 65 years: 23.9%	0-14 years: 29.4% 15-64 years: 65.5% $\geq$ 65 years: 5.1%
Total population	10,085,638	127,368,088	29,179,952

* CIA World Factbook 2012

- Required information to do standardization:

  - Direct standardization
    - $\rightarrow$ Stratum-specific mortality rate of study populations.
    - $\rightarrow$ Stratum size of standard population.
  - Indirect standardization
    - $\rightarrow$ Stratum-specific mortality rate of standard population.
    - $\rightarrow$ Crude mortality rate of study population.
    - $\rightarrow$ Stratum size of study population.

Direct Standardization

- Stratum-specific mortality rate of each study population is available.
- Comparing across study populations through a standard population.
- As if the comparison populations have the same age structure with standard population $\rightarrow$ standardized through standard population.
- The standard population serves as weight, using rate from study populations,
- Directly standardized rate,

$$\text{Directly standardized rate} = \frac{\sum \text{stratum rate (study pop.)} \times \text{stratum size (std. pop)}}{\text{std. pop. total}}$$

$$R_S = \frac{\sum r_k N_k}{N}$$

also standardized rate ratio (SRR) and standardized rate difference (SRD),

$$\text{SRR} = \frac{R_{S1}}{R_{S2}} \quad \text{and} \quad \text{SRD} = R_{S1} - R_{S2}$$

Example 1:

Age	Somalia			Japan			Malaysia		
	Pop.	Death	Rate	Pop.	Death	Rate	Pop.	Death	Rate
0 – 14	4488109	87563	19.51	17194692	6840	0.40	8578906	27452	3.20
15 – 64	5355474	55429	10.35	79732423	695267	8.72	19112869	94035	4.92
64 & Above	242055	3754	15.51	30440973	463312	15.22	1488178	22953	15.42
	10085638	146746	14.55	127368088	1165418	9.15	29179952	144441	4.95

Calculate:

1. Standardized mortality rate for Somalia and Japan, using Malaysia as standard population.
2. Standardized rate ratios and standardized rate difference for Japan and Somalia.

e.g. for Somalia, standardized mortality rate:

$$R_S = \frac{(19.51 \times 8578906) + (10.35 \times 19112869) + (15.51 \times 1488178)}{29179952} = 13.31 \text{ per thousand}$$

Indirect Standardization

- Stratum-specific mortality rate of each study population is not available, or too small.
- Only stratum size of study populations is available.
- Stratum-specific mortality rate of standard population is available.
- Calculate number of death by stratum in study population as if the rate is similar to standard population → yields expected number of death.
- Obtain Standardized Mortality Ratio (SMR).

$$SMR = \frac{\text{Observed death}}{\text{Expected death}} = \frac{\text{Observed death}}{\sum \text{stratum rate (std. pop.)} \times \text{stratum size (study pop.)}}$$

$$SMR = \frac{d}{\sum R_k n_k}$$

then obtain indirectly standardized rate,

$$\text{Indirectly standardized rate} = SMR \times \text{Crude death rate (std. pop.)}$$

$$R_I = \frac{d}{\sum R_k n_k} \times R$$

- However, not recommended to calculate the rate ratio and difference → not comparable as stratum size of study population is used as weight (Schoenbach, 2003).

Example 2:

Age	Somalia			Japan			Malaysia		
	Pop.	Death	Rate	Pop.	Death	Rate	Pop.	Death	Rate
0 – 14	4488109	-	-	17194692	-	-	8578906	27452	3.20
15 – 64	5355474	-	-	79732423	-	-	19112869	94035	4.92
64 & Above	242055	-	-	30440973	-	-	1488178	22953	15.42
	10085638	146746	14.55	127368088	1165418	9.15	29179952	144441	4.95

Calculate:

1. Standardized mortality ratio for Somalia and Japan, using Malaysia as standard population.
2. Indirectly standardized rate for Somalia and Japan.

e.g. for Japan, standardized mortality ratio and indirectly standardized rate:

$$R_I = \frac{1165418}{(\frac{3.2}{1000} \times 17194692) + (\frac{4.92}{1000} \times 79732423) + (\frac{15.42}{1000} \times 30440973)} \times 4.95$$

$$R_I = 1.27 \, (\text{i.e. SMR}) \times 4.95 = 6.29 \, \text{per thousand}$$

Using MS Excel

Refer attached MS Excel file "Standardization of Rates.xls" for using spreadsheet to standardize rate (directly and indirectly).

References

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