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#### STANDARDISATION GUIDANCE

#### Calculation of standardised rates and ratios:

#### Direct and indirect methods

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# 1. Introduction

Rates based on populations are used in many contexts to provide measures of the frequency of events of interest (e.g. emergency hospital admissions, deaths).

A crude rate is simply the number of events per head of population (or expressed, for example, per 100,000 population). Calculation of a crude rate requires only the total number of events and the population size. It is generally calculated on an annual basis, although ‘per year’ is assumed rather than stated.

A standardised rateorratio is calculated by adjusting the crude rate to take into account the structure of the population. There are two types of standardisation – direct and indirect. They both rely upon reference to a single standard population, which has a known structure. The appropriate choice of standard population will depend upon the rate to be calculated. A standardised rate or ratio provides a comparison against a common standard; and a directly standardised rate can also be compared with the standardised rate for another population of interest (e.g. comparison of rates for two health board areas). Calculation of a standardised rate or ratio requires more detailed information about population structures and the frequency of events than is needed to calculate a crude rate.

This document gives a practical description of the calculation of standardised rates (direct standardisation) and standardised ratios (indirect standardisation). It does not go into great detail about the concepts, interpretation and reasons for applying standardisation to health data. Direct and indirect standardisation methods are described, together with brief guidance on their appropriate use. For simplicity, the examples in the text and the associated Excel file are restricted to age standardisation. The same method can be extended to age-sex and to even more complex standardisation. Standardisation using age alone is not recommended in practice where the data relate to both sexes, because the age structure of a population often differs between the sexes.

# 2. Standardisation

The aim of standardisation is to provide a summary ‘adjusted’ rate or ratio to take into account underlying differences in the structure (age, sex, deprivation etc) of a study population relative to a ‘reference’ or standard population.

A crude rate is the number of events (e.g. deaths) per head of population and calculated per year. If two populations (e.g. NHS boards) have different age/sex structures (e.g. one is more elderly than the other) then it is likely that the crude rates will differ quite markedly (e.g. be higher in the more elderly board area), even though the rates for each age/sex group within the two board populations are similar. In such a situation, the standardised rate or ratio for the two populations would be similar and would be a more appropriate comparator than the crude rate for epidemiological purposes.

In some cases, standardisation may be misleading because the standardised rate or ratio summarises the data in just one figure. This may disguise different patterns in specific age groups or between the sexes. **You should always look carefully at the data before standardising.**

For simplicity, the examples below are restricted to age standardised rates or ratios. The method extends to all other types of standardisation, e.g. age-sex or age-sex-deprivation standardisation (see sections 3.4 and 4.4).

# 3. Direct age standardisation

It is rarely appropriate to standardise data for both males and females by age alone. Age standardisation is used here to simplify the explanation of the process.

A directly age standardised rate is a theoretical rate, based on the rates observed in the study population within the chosen age groups, and the relative frequencies of these age groups within a standard population. The replacement of the age group frequencies in the study population with those in the standard population gives the rate that would be observed if the age structure of the study population were the same as that of the standard population. This allows for fairer comparison between study populations with differing age structures.

The standard population should be a relevant and larger population than your study population, with ideally a similar age/sex structure. It should be referred to as the ‘standard population’. In practice, the European Standard Population is widely used for Scottish data. The World Standard Population is a very ‘young’ population and not generally appropriate for Scottish data.

Examples of standard populations are:

* European
* World
* World Cancer
* Scotland - usually limited to Census years (e.g. 1991, 2001 etc), **but the standard population must be fixed on a single year to make valid comparisons over time.**

**3.1. Change to European Standard Population**

The European Standard Population (ESP) is an artificial population structure which is used in the weighting of mortality or incidence data to produce age standardised rates. Through this analysis, it is possible to compare standardised mortality and morbidity rates between countries and within countries even when they have quite different population structures. The European Standard Population was originally introduced in 1976. The statistical institute of the European Union, Eurostat has recognised that there was a need to bring this population structure up to date in order to reflect changes in population. Following discussion with member states, a new ESP (ESP2013) has been created which is based on an average of states' population projections for 2011 - 2030. Statistics providers across the UK, have switched to using the ESP2013 from 2014 onwards. The impact of the change from the 1976 version to 2013 version is likely to look substantial. This is due to the way in which the European population has changed between 1976 and the projected average (2011-2030). Details of the change in European Standard Population can be seen in the appendix.

**Please note the following important points:**

* As new publications/analyses are produced, existing time trends should be revised to be calculated using ESP2013 going forward.
* European Age or Age-Sex Standardised Rates (EASRs) should be calculated using ESP2013 for all years in time trends containing data for 1994 onwards.
* Time trends that do not include post-1994 data should continue to use ESP1976.
* **Do not combine both of the European Standard Population versions in the same time trend.**
* All analyses containing standardised rates using the European Standard Population should state which version has been used.
* If there is an existing target (e.g. HEAT Target) which uses ESP1976-based-rates and this is still ongoing, then use ESP1976 to calculate EASRs until the target is complete.
* Analyses should emphasise that, if ESP1976-based rates are produced for 2013 onwards, they are provided only for specific "legacy" purposes, and that the ESP2013-based rates should be used for all other purposes.
* As a general rule, a lower age group of 0-4 should be used should for all analyses using ESP2013, however for conditions prevalent amongst children, it is recommended to split the lower age-group into two age groups: 0 and 1-4. **Please ensure your syntax for calculations of EASRs reflects this.**
* The upper age group for the 2013 European Standard Population structure is 95+. However, due to Scotland population estimates data being unavailable for the 95+ age group for all required geographies and for all required years, an upper age group of 90+ should be used for all analyses using ESP2013. This is an amalgamated age group containing both the 90-94 and 95+ age groups. National Records of Scotland (NRS) have no confirmed date for when the population estimates for the 95+ age group will be available for all required years and for all required geographies. In Scotland we will use an upper age group of 90+ for national and sub-national analyses for the foreseeable future. In time, Scotland will move to 95+ as population data become available. An upper age group of 90+ should be used for all analyses using ESP2013. Calculations should be based on 19 age groups (0-4, 5-9 up to an upper age group of 90+). **Please ensure your syntax for calculations of EASRs reflects this.**
* Standard Populations have different upper age-groups and this should be reflected in standardised rate calculations (in SPSS syntax, Excel etc). The World Standard Population and ESP1976 have an upper age group of 85+, and this should be the upper age group used in calculations. Whereas the ESP2013 has an upper age group of 95+, with the upper age group of 90+ being used in calculations as described in the point above. **Please ensure your syntax for calculations of EASRs reflects this.**

# 3.2. Worked examples of a directly age standardised rate

**Example 1:** Age standardised rates for all persons for drug-related hospital discharges in Scotland in 2012/13 (based on the 2013 European Standard Population as the standard population).

**Step 1. Calculation of age-specific rates and the crude rate**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  |  |  |  | Age-specific |
| Age | No. of |  | Population |  | rate per 100,000 |
| group | discharges |  |  |  | (ai) |
| (i) | (ni) |   | (pi) |   | (ni / pi)\*100,000 |
| 0-4 |  0 |  |  295,871 |  |  0.00 |
| 5-9 |  0 |  |  275,541 |  |  0.36 |
| 10-14 |  15 |  |  281,597 |  |  5.33 |
| 15-19 |  211 |  |  319,783 |  |  65.98 |
| 20-24 |  515 |  |  370,639 |  | 138.95 |
| 25-29 |  744 |  |  347,050 |  | 214.38 |
| 30-34 |  1,071 |  |  332,962 |  | 321.66 |
| 35-39 |  1,069 |  |  322,008 |  | 331.98 |
| 40-44 |  937 |  |  385,460 |  | 243.09 |
| 45-49 |  589 |  |  410,305 |  | 143.55 |
| 50-54 |  291 |  |  384,707 |  |  75.64 |
| 55-59 |  106 |  |  339,288 |  |  31.24 |
| 60-64 |  59 |  |  322,638 |  |  18.29 |
| 65-69 |  30 |  |  285,732 |  |  10.50 |
| 70-74 |  13 |  |  221,533 |  |  5.87 |
| 75-79 |  10 |  |  180,611 |  |  4.98 |
| 80-84 |  14 |  |  128,633 |  |  10.88 |
| 85-89 |  9 |  |  72,337 |  |  6.91 |
| 90+ |  0 |   |  36,905 |   |  10.84 |
| All ages |  5,683 |  |  5,313,600 |  | 106.95 |

The age-specific rate, per 100,000 population for age group i

 = Admissions in age group *i* \* 100,000

 Population in age group *i*

For above example, patients aged 60-64:

Age-specific rate (60-64) = (59 / 322,638) \* 100,000

 = 18.29 per 100,000 population

The crude rate (all ages)per 100,000 population

##  = Total number of admissions \* 100,000

 Total population at risk

For above example:

 Crude rate = (5,683 / 5,313,600) \* 100,000

 = 106.95 per 100,000 population

Please note:

1. Calculating age-specific rates is only possible if the number of events (e.g. admissions, discharges) and population at risk are available by suitable age groups.

2. The crude rate is always calculated on a ‘per year’ basis. In the example above, the discharges are for a single financial year (2012/13), and the population at risk is the 2012 mid-year population estimates, therefore the crude rate is correct. If you had 5 years of discharges aggregated (e.g. for the period 2008/09-2012/13), you would need to ensure that you also used a population for 5 years (e.g. mid-year population estimates for 2008-2012).

# Step 2. Applying age-specific rates to the standard population

|  |  |  |  |
| --- | --- | --- | --- |
| Age group | European Standard Population 2013 (ESP2013) | Age-specific rate (asr) per 100,000 | asr\*ESP2013 |
| (i) | (ei) | (ai) | (ai \* ei) |
| 0-4 | 5,000 | 0.00  | 0 |
| 5-9 | 5,500 | 0.00  | 0 |
| 10-14 | 5,500 | 5.33  | 29,297 |
| 15-19 | 5,500 | 65.98  | 362,902 |
| 20-24 | 6,000 | 138.95  | 833,695 |
| 25-29 | 6,000 | 214.38  | 1,286,270 |
| 30-34 | 6,500 | 321.66  | 2,090,779 |
| 35-39 | 7,000 | 331.98  | 2,323,855 |
| 40-44 | 7,000 | 243.09  | 1,701,603 |
| 45-49 | 7,000 | 143.55  | 1,004,862 |
| 50-54 | 7,000 | 75.64  | 529,494 |
| 55-59 | 6,500 | 31.24  | 203,072 |
| 60-64 | 6,000 | 18.29  | 109,720 |
| 65-69 | 5,500 | 10.50  | 57,746 |
| 70-74 | 5,000 | 5.87  | 29,341 |
| 75-79 | 4,000 | 4.98  | 19,932 |
| 80-84 | 2,500 | 10.88  | 27,209 |
| 85-89 | 1,500 | 12.44  | 10,663 |
| 90+ | 1,000 | 0.00  | 0 |
| All ages | 100,000 | 1,640.43 | 10,630,658 |
|  |  |  |  |

The **European Age Standardised Rate** (EASR)

##  = Sum of *(ai \*ei)* over all *i* age groups

 Sum of *ei* over all *i* age groups

 = 10,630,658 / 100,000

 = 106.31 per 100,000 population

The age standardised rate (106.31 per 100,000 population) is slightly lower than the crude rate (106.95 per 100,000 population) calculated at Step 1 above. The age structure is very similar for both populations; however there is a slight difference. The study population (Scotland, 2012) has a slightly younger age structure than the European Standard Population 2013, and the age-specific rates are low for children and high for old people.

NB. The units of EASR are those of the age-specific rates above i.e. rate per 100,000 population. This example shows that the directly age-standardised rate is simply a weighted average of the age-specific rates. The weights are the proportions of the standard population lying within each age group.

# Worked examples in Excel

The “Standardisation” Excel spreadsheet below has worked examples of direct age-standardising on the ‘DIRECT examples’ worksheet.



# Truncated rates

When you need to calculate a directly standardised rate for an age group other than all ages (e.g. for 0-74 years, or age 55+), you can use the same methodology but calculate a ‘truncated’ rate. This is achieved by ignoring the data for the section of the population falling outside the required limits.

An example for 55+ years is shown in the “standardisation” spreadsheet below, under Example 4 on worksheet ‘DIRECT examples’.

#

# Syntax

The syntax file below contains an example of how to calculate age-sex standardised rates in SPSS.



**Step 3. 95% Confidence intervals for directly standardised rates**

Confidence intervals can be obtained using the Normal approximation for large samples. This method requires a standard error for the rate (EASR in this example) calculated from the data and the appropriate value from the Normal distribution (1.96 for a 95% confidence interval). There are two methods for calculating the standard error; the binomial method is appropriate for large rates and the Poisson for small rates. The two calculations will usually produce a very similar result.

(i) Binomial (for ‘large’ observed rates – i.e. when comparing the number of events with the number of the population)

Var (EASR) = Sum of {aiei2 (100,000-ai)/ni} across all *i* age groups

 {Sum of standard population over all *i* age groups}2

Standard error (EASR) = square root (variance (EASR))

(ii) Poisson (for ‘small’ observed rates - i.e. when comparing the number of events with the number of the population)

Var (EASR) = Sum of {aiei2 \* 100,000 /ni} across all *i* age groups

 {Sum of standard population over all *i* age groups}2

Standard error (EASR) = square root (variance (EASR))

***Recommendation:*** In practice the Poisson variance is most commonly used because observed rates are usually ‘small’.

Finally the **95% confidence limits** (CLs) are calculated as follows:

Lower 95% CL= EASR – 1.96\*Standard error

Upper 95% CL= EASR + 1.96\*Standard error

The 95% confidence interval is (Lower 95% CL, Upper 95% CL)

For wider or narrower confidence intervals, the appropriate values from the Normal distribution can be obtained from statistical tables. The most common alternatives are 99% (use 2.58 in place of 1.96) and 90% (use 1.64 in place of 1.96).

For a worked example, please see example 3 on the ‘DIRECT examples’ worksheet on the “Standardisation” spreadsheet above.

**Dobson’s Method (using Byar’s approximation)**

For rates that assume the Poisson distribution, the confidence limits for the EASR are given by Dobson’s method. This is the recommended method described in the APHO paper:

<http://www.apho.org.uk/resource/item.aspx?RID=48457>

This method should be used when the number of cases is very small and will not obtain negative lower a confidence limit which can happen when the method’s above are used.

# 3.3. Advantages of direct standardisation

* Two directly standardised rates calculated using the same standard population can be compared, and differences tested for statistical significance.
* It is appropriate for trend analysis as rates can easily be compared over time, providing the same standard population is applied to the entire period of any comparison.

# 3.4. Disadvantages of direct standardisation

1. When the numbers of events (e.g. admissions) are small, the estimated rates may be unreliable.

# 3.5. Other points to consider

1. In some cases it may be appropriate to use a truncated age range (e.g. 0-64 years or 75+ years) instead of the full age range when performing standardisation.
2. Age-specific rates may differ between the sexes. It is good practice to present separate standardised rates for males and females, unless there is good reason to do otherwise. When calculating a combined rate for both sexes, it is best to calculate an age-sex standardised rate, by including sex as well as age in the calculation (see Further Reading (1) on p12).
3. It is also possible to perform an age-sex-deprivation standardisation, to compare two populations after allowing for structural differences between the populations in age, sex and deprivation. See, for example, the ISD Scotland website: General Practice - Practice Team Information (PTI):

<http://www.isdscotland.scot.nhs.uk/Health-Topics/General-Practice/Publications/2011-02-22/2011-02-22-PTI-report.pdf?815981627> (see page 8) and

<http://www.isdscotland.org/Health-Topics/General-Practice/PTI-Statistics/Statistical-notes.asp>.

1. Standardisation may be misleading in some cases because the standardised rate summarises the data in just one figure. This could disguise different patterns in specific age groups or between the sexes. You should always look carefully at the data before standardising.

# 4. Indirect age standardisation

As in the case of direct standardisation, it is rarely appropriate to indirectly standardise data for both males and females by age alone. Age standardisation is, however, used here to simplify the explanation of theprocess. Indirect age standardisation is based on a comparison of observed to expected numbers of events or cases, achieved by applying age-specific rates from a ‘standard population’ to the population of interest. For example, if the study population is within an NHS board of residence then the standard population might be taken as Scotland.

Depending on the data used, indirect standardisation can produce the following measures:

* Standardised Incidence Ratio (SIR) – when using disease incidence data
* Standardised Registration Ratio (SRR) – when using registration data (e.g. for cancer)
* Standardised Mortality/Morbidity Ratio (SMR) – when using mortality (or morbidity) data
* Standardised Operation Ratio (SOR) – when using hospital operation data.

We showed above that in direct standardisation we calculate age-specific rates for our ‘population of interest’ (e.g. Scotland) and apply these to the age structure of a standard population (e.g. Europe). In indirect standardisation this concept is reversed.

The following example of indirect standardisation calculates the number of cases that would be ‘expected’ in Greater Glasgow NHS Board (population of interest) if the age-specific rates for Scotland (the standard population in this example) were applied. This ‘expected’ number is compared to the actual ‘observed’ number and is usually expressed as a ratio (observed/expected).

# 4.1. Worked example of an indirectly age standardised ratio

Please see the “Standardisation” spreadsheet: Example 5 on worksheet ‘INDIRECT examples’. This example calculates the standardised incidence ratio (SIR), based on:

* lung cancer cases in males in Greater Glasgow NHS Board for the period 1986-1995 and
* Scotland Population for the same period (the standard population).

# Step 1. Calculation of age-specific rates for our standard population

The chosen standard population must have an age breakdown of cases and population at risk so that age-specific rates can be calculated. If age-sex standardisation is required then the standard population must have this breakdown by age and sex.

|  |  |  |  |
| --- | --- | --- | --- |
| Agegroup(i) | Incident cases in standard population(ri) | Population at risk(ni) | Age-specific rate per100,000 population(ai) |
| 0-4 | 0 |  1,651,611 |  0.00 |
| 5-9 | 0 |  1,642,813 |  0.00 |
| 10-14 | 0 |  1,632,195 |  0.00 |
| 15-19 | 0 |  1,792,083 |  0.00 |
| 20-24 | 0 |  2,046,703 |  0.00 |
| 25-29 | 17 |  2,022,557 | 0.84 |
| 30-34 | 28 |  1,869,892 |  1.50 |
| 35-39 | 84 |  1,730,250 |  4.85 |
| 40-44 | 258 |  1,673,215 |  15.42 |
| 45-49 | 638 |  1,528,606 |  41.74 |
| 50-54 | 1,231 |  1,377,423 |  89.37 |
| 55-59 | 2,564 |  1,319,079 |  194.38 |
| 60-64 | 4,510 |  1,241,165 |  363.37 |
| 65-69 | 5,917 |  1,089,820 |  542.93 |
| 70-74 | 5,839 |  827,641 |  705.50 |
| 75-79 | 4,734 |  568,331 |  832.97 |
| 80-84 | 2,955 |  323,911 |  912.29 |
| 85-89 | 1,004 |  121,745 |  824.67 |
| 90+ | 347 |  34,924 |  993.59 |
| All ages | 30,126 | 24,493,964 |  122.99 |

The age-specific rate, per 100,000 population for age group i

## = 100,000\*(Cases in age group i) / (Population in age group i)

For example (see table above), for people aged 90 years and over:

 Age-specific rate (90+) = 100,000\*(347 / 34,924)

 = 993.59 per 100,000 population

The crude rate (all ages)per 100,000 population

 = 100,000\*(30,126 / 24,493,964)

 = 122.99 per 100,000 population

**Please note:** Calculating age-specific rates is only possible if the standard population is available by the required age bands.

**Step 2. Applying age-specific rates for the standard population to the study population**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Agegroup(i) | Observedno. ofcases(in HB)(ri) | Age-specific rates per 100,000  in standard pop.(Scotland) (ai) | Study population (HB)(ni) | Expectednumber ofcases(in HB)(ai\*ni /100,000) |
| 0-4 |  0 |  0.00 |  305,027 |  0.00 |
| 5-9 |  0 |  0.00 |  291,668 |  0.00 |
| 10-14 |  0 |  0.00 |  277,204 |  0.00 |
| 15-19 |  0 |  0.00 |  316,514 |  0.00 |
| 20-24 |  0 |  0.00 |  393,971 |  0.00 |
| 25-29 |  0 |  0.84 |  390,574 |  3.28 |
| 30-34 |  9 |  1.50 |  344,642 |  5.16 |
| 35-39 |  24 |  4.85 |  295,071 |  14.33 |
| 40-44 |  67 |  15.42 |  269,057 |  41.49 |
| 45-49 |  161 |  41.74 |  251,238 |  104.86 |
| 50-54 |  337 |  89.37 |  240,068 |  214.55 |
| 55-59 |  670 |  194.38 |  240,782 |  468.03 |
| 60-64 | 1,154 |  363.37 |  230,205 |  836.49 |
| 65-69 | 1,440 |  542.93 |  199,367 | 1,082.43 |
| 70-74 | 1,348 |  705.50 |  150,158 | 1,059.36 |
| 75-79 | 1,157 |  832.97 |  101,731 |  847.38 |
| 80-84 |  697 |  912.29 |  56,291 |  513.54 |
| 85-89 |  258 |  824.67 |  20,410 |  168.32 |
| 90+ |  41 |  993.59 |  5,198 |  51.65 |
| All ages | 7,363 |  122.99 | 4,379,176 | 5,410.84 |

Age-specific expected number of cases for age group i

= (rate for standard population\*population at risk) for age group i / 100,000

For people aged 90 years and over:

Age-specific expected number (90+) = (993.59\*5,198)/100,000

= 51.65

Expected number of cases in HB

= Sum of (age-specific expected numbers) over all age groups

 = 5,410.86

Observed number of cases in HB = 7,363

SIR = (Observed / Expected) \* 100

 = (7,363 / 5,410.86)\*100

 = 136.08

**Step 3. 95% Confidence intervals for indirectly standardised ratios**

The Normal approximation can be used to calculate confidence limits for the indirectly standardised ratio (e.g. SIR):

VAR (SIR\*100) = 10,000 \* observed / (expected) 2

Standard Error (SIR) = SQRT (VAR(SIR))

 = 100 \* SQRT(observed) / (expected)

The approximate 95% Confidence Limits (CLs) are calculated as follows:

Lower 95% CL = SIR – 1.96\*Standard error

Upper 95% CL = SIR + 1.96\*Standard error

The 95% confidence interval is (Lower 95% CL, Upper 95% CL).

**95% Confidence interval for worked example**

Lower 95% CL =136 – 1.96 \* (100\*SQRT(7,363)/5,410.84) = 132.97

Upper 95% CL =136 + 1.96 \* (100\*SQRT(7,363)/ 5,410.84) = 139.19

Therefore, the estimated SIR is 136.1 and the approximate 95% confidence interval for the SIR is (133.0, 139.2).

# 4.2. Advantages of indirect standardisation

* The results from indirect standardisation are all relative to a ‘standard’ and differences between populations can be expressed in simple terms.
	+ For example, if the age-specific rates for male lung cancer cases in our example were identical to those for Scotland as a whole, the SIR for Glasgow would be 100. However, in the given example, the SIR is 136.1. Another way to express this would be to say that the incidence of lung cancer in men in Glasgow is 36.1% above the Scottish average.
	+ The SIR for lung cancer in men in Lothian NHS Board is 101.7, 1.7% above the Scottish average (but in fact, with CLs of 98.7 and 104.8, the difference from Scotland is not statistically significant).

# 4.3. Disadvantages of indirect standardisation

* Two indirectly standardised ratios are **not** comparable to each other; they are only comparable to the chosen standard. Using the examples for Glasgow and Lothian above, it would not be correct to try and quantify the difference between the two SIRs of 136.1 and 101.7. It would only be correct to say that Glasgow had a numerically higher SIR than Lothian.
* There are real pitfalls in using indirect standardisation to compare areas (or to compare a single area over time) because differences in population structures between the areas (or the times) being compared may affect the results.
* It may not be possible to calculate an indirectly standardised ratio if, for example, data on the disease or event of interest is not available for the standard population broken down by all necessary factors (e.g. age, sex).

# 4.4 Other points to consider

1. Remember that – unlike direct standardisation – indirect standardisation gives a ratio rather than a rate. Ratios for different areas are not comparable to each other, only to the chosen standard.
2. In some cases it may be appropriate to use a truncated age range (e.g. 0-64 years or 75+ years) instead of the full age range when performing standardisation.
3. Age-specific rates may differ between the sexes. It is good practice to present separate standardised rates or ratios for males and females, unless there is good reason to do otherwise. When calculating a combined rate/ratio for both sexes, it is best to calculate an age-sex standardised rate/ratio, by including sex as well as age in the calculation (see Further Reading (1) on p15).
4. It is also possible to perform an age-sex-deprivation standardisation, to compare two populations after allowing for structural differences in the population in age, sex and deprivation. See for example Scottish Clinical Indicators on the Web, July 2009

(<http://www.indicators.scot.nhs.uk/TrendsJuly09/Main.html>).

1. Standardisation may be misleading because the standardised rate/ratio summarises the data in just one figure. This may disguise different patterns in specific age groups or between the sexes. You should always look carefully at the data before standardising.

# 5. Summary

# Comparison of direct and indirect methods of standardisation

*based on age-sex standardisation*

|  |  |  |
| --- | --- | --- |
|  | **Direct****Standardisation** | **Indirect** **Standardisation** |
| *Data required* |  |  |
| Population of interest(study population) | Age-sex specific rates | Age-sex compositionand total cases |
| Standard population | Age-sex composition | Age-sex specific ratesand overall rate |
| *Method* | Rates for population of interest are applied to standard population | Standard rates applied to population of interest |
| *Result* | Age-sex standardised **rate**  | Standardised (incidence/mortality/morbidity) **ratio**  |
| *Main advantage* | Allows easy comparison of several areas and over time | Easy to compare an areato a standard |
| *Main disadvantage* | May be unreliable when there are small numbers of events | Does not allow easy comparison of several areas or over time |

#

# 6. Further reading

Some further reading material can be found below:

1. APHO technical briefing on commonly used public health statistics and their confidence intervals (includes a discussion of direct and indirect age standardisation) <http://www.apho.org.uk/resource/item.aspx?RID=48457>
2. Washington State Department of Health guidance on calculation of crude rates and directly standardised rates. <http://www.doh.wa.gov/data/Guidelines/Rateguide.htm#directmethaa>
3. Eastern Region PHO technical briefing on standardisation, which calculates and comments on both directly and indirectly standardised rates and includes the calculation of confidence intervals.  [http://www.erpho.org.uk/viewResource.aspx?id=12267](%20http%3A//www.erpho.org.uk/viewResource.aspx?id=12267)
4. Office for National Statistics (ONS) Guidance for the changes to the European Standard Population: <http://www.ons.gov.uk/ons/guide-method/user-guidance/health-and-life-events/revised-european-standard-population-2013--2013-esp-/index.html>

# Appendix

Comparison of ESP1976 and ESP2013

**Chart 1**: Comparison of ESP1976 and ESP2013

