

## AGE-ADJUSTED DEATH RATE

### 1. Definition:

AGE-ADJUSTED DEATH RATE is a death rate that controls for the effects of differences in population age distributions. When comparing across geographic areas, some method of age-adjusting is typically used to control for the influence that different population age distributions might have on health event rates.

Direct age-adjustment (or age standardization) is the same as calculating a weighted average. It weights the age-specific rates observed in a population of interest by the proportion of each age group in a standard population (Lilienfeld & Stolley, 1994).

In 1998, the Centers for Disease Control and Prevention revised the standard population weights for direct age-adjustment ([Klein & Schoenborn](#)), replacing the 1940 U.S. standard population weights that had been used for the previous several decades. Table 1., below, contains the standard population weights published by the CDC. They represent the proportion of the U.S. 2000 population in each age group, and sum to 1.0.

**Table 1. US2000 Standard Population Weights for Age Standardization**

	Age Group	U.S. 2000 Population Projection (in thousands)	Weight
1	Under 1 Year	3,795	0.013818
2	1 - 4 Years	15,192	0.055317
3	5 - 14 Years	39,977	0.145565
4	15 - 24 Years	38,077	0.138646
5	25 - 34 Years	37,233	0.135573
6	35 - 44 Years	44,659	0.162613
7	45 - 54 Years	37,030	0.134834
8	55 - 64 Years	23,961	0.087247
9	65 - 74 Years	18,136	0.066037
10	75 - 84 Years	12,315	0.044842
11	85 Years and Over	4,259	0.015508

### 2. Calculation:

To apply direct age-adjustment to a set of rates, the age-specific rate for each age group in the study population is multiplied by the appropriate weight in the standard population. The sum of these products is the directly age-adjusted, or age-standardized rate. The age-adjusted rate can be considered an average of each of the individual age-specific rates, but rather than being a simple average, it is a weighted average with each age-specific rate weighted by the proportion of people in the same age group in the standard population.

### 3. Examples:

Tables 2a. and 2b. demonstrate the method used in calculating age-adjusted rates. Notice that using crude death rates in Tables 2a. and 2b., one might conclude that persons in Sierra County have a higher underlying risk for Diabetes death compared with the state of New Mexico.

**Table 2a. Age-adjusted Death Rate for Diabetes Mellitus, State of New Mexico, 2003-2005**

Age Group	Number of Deaths (3-Year Sum)	Population Counts (3-Year Sum)(1)	Age-Specific Rate (2)	US2000 Std Pop Weight	Gross Products (3)
Under 1 Year	0	84,952	0	0.013818	0
1 - 4 years	0	325,508	0	0.055317	0
5 - 14 years	2	828,663	0.24	0.145565	0.30502
15 - 24 years	2	893,809	0.22	0.138646	0.030502
25 - 34 years	19	718,484	2.64	0.135573	0.357918
35 - 44 years	61	810,632	7.52	0.162613	1.222855
45 - 54 years	160	833,948	19.19	0.134834	2.587478
55 - 64 years	297	602,768	49.27	0.087247	4.298757
65 - 74 years	443	381,451	116.14	0.066037	7.669339
75 - 84 years	546	235,030	232.31	0.044842	10.41697
85 years and over	369	82,660	446.41	0.015508	6.923177
All Ages	1,899	5,797,906	32.754 (4)	1	<b>33.54 (5)</b>

**Table 2b. Age-adjusted Rate for Diabetes Mellitus, Sierra County, New Mexico, 2003-2005**

Age Group	Number of Deaths (3-Year Sum)	Population Counts (3-Year Sum)(1)	Age-Specific Rate (2)	US2000 Std Pop Weight	Cross Products (3)
Under 1 Year	0	350	0	0.013818	0
1 - 4 years	0	1,266	0	0.055317	0
5 - 14 years	0	4,384	0	0.145565	0
15 - 24 years	0	4,526	0	0.138646	0
25 - 34 years	0	2,977	0	0.135573	0
35 - 44 years	1	4,269	23.43	0.162613	3.81038
45 - 54 years	0	5,581	0	0.134834	0
55 - 64 years	1	5,985	16.71	0.087247	1.457931
65 - 74 years	11	5,946	185.01	0.066037	12.21719
75 - 84 years	6	4,086	146.85	0.044842	6.584872
85 years and over	3	1,584	189.45	0.015508	2.938097
All Ages	22	40,952	53.72 (4)	1	<b>27.01 (5)</b>

(1) Bureau of Business and Economic Research (BBER), UNM.

(2) Rate per 100,000 = (Age-specific death count \* 100,000) / Age-specific population count

(3) Age-specific death rate \* US2000 Std Pop Weight

(4) Crude death rate

(5) **Age-adjusted rate.**

#### 4. Technical Notes:

- When reporting age-adjusted rates, always report the standard population used. When comparing age-adjusted results to other data, be sure to document that those data were age-adjusted to the same standard population, and report the standard population.
- The age-adjusted rate is hypothetical, and is useful only for comparing populations, either over time, by geographic area, by sex or by racial/ethnic subgroups.
- Although age-adjustment may be used with broad population age groups, such as adults (e.g., age 18+), it is not necessary (or meaningful) to age-adjust data for smaller age groups (e.g., age 18-24).
- Age adjustment is not appropriate if the age-specific death rates in the population of interest do not have a consistent relationship. For example, if death rates among younger persons are increasing over time, but death rates among older persons are decreasing over

time, you would not want to age-adjust rates across years. One's conclusion of the trend in this death rate would be different, depending on which standard population is used. A younger standard population (such as the US 1940) would show an increase, whereas an older standard population (such as the US 2000) would show a decrease or no change at all. Care should be taken so that the selection of the standard population does not affect the comparisons. For more information, see [Curtin & Klein](#).

- In order to determine reliability and the chance variation of a death or mortality rate (especially those based on smaller numbers of events) as well as to determine significant changes over time or significant differences when comparing rates (e.g. a county rate to the state rate), it is highly recommended that a standard error or [confidence interval](#) (usually at 95%) be calculated and shown for the rates.
- In some cases, such as when there are too few cases to stratify by age, "indirect age standardization" may be used. Indirect standardization is based on standard mortality and morbidity ratios (SMR), and adjusts the age-specific rates found in the standard population to the age distribution of the smaller area or sub-population. According to Curtin & Klein, "One of the problems with [direct age adjustment] is that rates based on small numbers of deaths will exhibit a large amount of random variation. A very rough guideline is that there should be at least 25 total deaths over all age groups." When fewer than 25 health events occurred over a time period, you may consider combining years, or using indirect age-adjustment.
- The direct method can present problems when population sizes are particularly small. Calculating directly standardized rates requires calculating age-group-specific rates, and for small areas these age-specific rates may be based on one or two events. In such cases, indirect standardization of rates may be used.
- Indirectly standardized rates are based on the standard mortality or morbidity ratio (SMR) and the crude rate for a standard population. Indirect standardization adjusts the overall standard population death rate to the age distribution of the small area (Lilienfeld & Stolley, 1994). It is technically appropriate to compare indirectly standardized rates only with the rate in the standard population, not with each other.
- The Division of Vital Statistics (DVS) at NCHS follows standards for use of the terms "death rate" and "mortality rate" in naming and reporting common vital statistics rates for deaths. The NAPHSIS standard measures shown here follow the DVS standards, primarily to maintain consistency with DVS for naming conventions. Please note that states/registration areas and other federal government organizations within and outside NCHS/CDC may not follow the DVS standards when naming and reporting death/mortality rates.

- According to DVS standards, the following naming conventions are used for the common vital statistics rates for deaths:

<u>Mortality Rates</u>	<u>Death Rates</u>
• Infant Mortality Rate	Crude Death Rate
• Neonatal Mortality Rate	Age-Specific Death Rate
• Postneonatal Mortality rate	Cause-Specific Death Rate
• Perinatal Mortality Rate	Age-Adjusted Death Rate
• Fetal Mortality Rate	
• Maternal Mortality Rate	

## **FAQs for Age-adjustment:**

### **Event Rates for a Subpopulation**

Q:I am looking at death rates for female breast cancer. Which standard population should I use, females in US 2000 or all persons?

A:Theoretically, it doesn't matter, as long as you use the same standard population for all your analyses. But the recommended standard population is now the U.S. 2000 total population, even for analyses that apply only to a particular sex, race, or other subgroup.

### **When NOT to Age-Adjust**

Q:Are there times I should NOT age-adjust?

A:Yes. Do NOT use age-adjustment when...

- You are comparing populations with similar age distributions, and age-adjustment does not produce a rate that is substantively different from the crude rate.
- You are comparing groups with the same, narrow, age range.
- Do not use Direct Age-adjustment if you have too few cases (you should have a least 25 events across all age groups). Instead, use Indirect Age-Adjustment.

### **Age Subpopulations**

Q: I am looking at adults, only. If I use the weights in Table 1, above, they will not sum to one. Is that okay?

A: No. The weights must always sum to one. Weights for certain age subgroups have been published by the CDC. But you may also recompute the proportions in Table 1, using only the age range that is relevant to your analysis.

### **Age/Sex Adjusted Rates**

Q: I have a report that uses age AND SEX adjusted rates. What is this, and why doesn't NM-IBIS produce age and sex adjusted rates?

A: It is sometimes appropriate to adjust by other variables besides age. Rates that have been adjusted by age and sex use age- and sex-specific rates, weighted by twice the number of weights (one set for males and one set for females), but the total of all the weights still must sum to 1.0. IBIS-Q doesn't compute these rates because there is little demand for it.

### **Confidence Intervals for Age-adjusted Rates**

Q: Can I use the confidence interval for the crude rate with the age-adjusted rate?

A: No, a new confidence interval for the age-adjusted rate must be calculated. Methods for calculation of this confidence interval may be found in [Curtin & Klein](#).

## **6. References:**

Curtin, LR, Klein, RJ. [Direct Standardization \(Age-Adjusted Death Rates\). Statistical notes; no.6](#). Hyattsville, Maryland: National Center for Health Statistics. March 1995.

Klein RJ, Schoenborn CA. [Age-Adjustment Using the 2000 Projected U.S. Population. Statistical notes; no.20](#). Hyattsville, Maryland: National Center for Health Statistics. January 2001.

Lilienfeld, DE and Stolley, PD. Foundations of Epidemiology, 3rd Ed. Oxford University Press, 1994.

(03/16/09)