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The Impacts of Changing to the Year 2000 Standard Population On Age-Adjusted Death Rates in Alaska

IN THIS ISSUE

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The crude death rate is commonly used to measure mortality. However, the age composition of the population can greatly influence the crude death rate. For example, since most deaths occur over 70 years of age, a population that is aging will naturally see an increase in the crude death rate. Therefore, using the crude death rate to measure trends can be misleading if the age distribution of the population has changed over time. To help overcome this and other limitations of the crude death rate, age adjustment is used in mortality statistics. Age adjustment needs a standard age distribution, usually called a standard population. The most frequently used standard in the United States is based on the 1940 US population. Beginning with 1999 mortality statistics, however, the US and the Bureau of Vital Statistics will begin using the year 2000 standard population for age adjustment.

One impact of changing the standard population is that comparisons with previously published age-adjusted death rates will be meaningless, since age-adjusted death rates using different standard populations are not directly comparable.

Generally, the year 2000 standard will give age-adjusted death rates that are much higher than those based on the 1940 standard. Other impacts of changing to the year 2000 standard will be previewed in this newsletter.

METHODS

The mortality data in this newsletter came from information reported on death certificates registered with the Bureau of Vital Statistics. The US Bureau of Census derived the projected age distribution for the year 2000 standard, which was converted to the standard million population by the National Center for Health Statistics (NCHS).

The most common form of age adjustment is called the direct method and requires a standard age distribution or a standard population. The choice of a standard population is arbitrary, but it is generally agreed it should not 'differ significantly' from the population being studied.

The 1940 standard million population has been in use by the federal government since 1943. During the past decade, several workshops met to consider changing the standard population. Statistically there are no compelling reasons to do this, but it was decided to change the standard population for two reasons: the 1940 standard population sounds dated and it has a younger age distribution than the current population. It was argued that the 1940 standard population gave the impression that the technical procedures used by the federal government are dated. And although it is a matter of opinion if the 1940 population is not 'normal' compared with the current population, the negative perception remains.

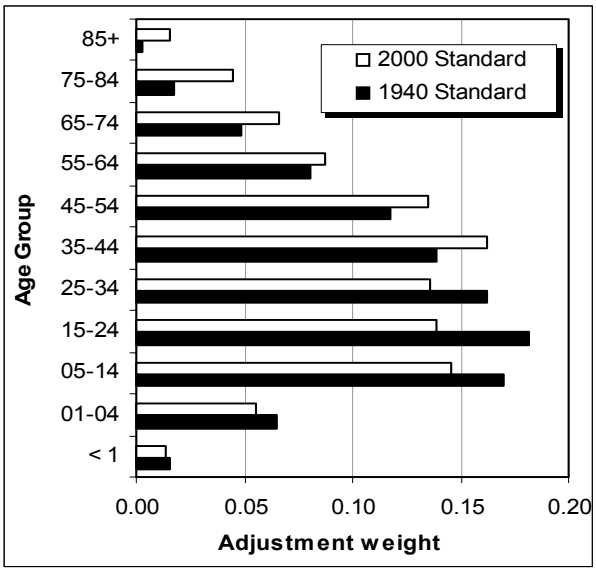

Figure 1. **Age-adjustment weights for the 1940 and year 2000 standard populations.**

Without going into great detail, an age-adjusted death rate is the weighted sum of age-specific death rates. The choice of the standard million population determines how much weight each age-specific rate contributes to the total. For details on how to calculate an age-adjusted rate, please refer to Appendix 1 at the end of this newsletter.

RESULTS

Age-Adjusted Death Rates

Figure 1 compares the age-adjustment weights for the 1940 and year 2000 standard populations. The 1940 standard gives more weight (emphasis) to younger age groups, giving the most emphasis to the 15 to 24 age group. The year 2000 standard gives the most emphasis the 35 to 44 age group. For deaths over 75 years, the year 2000 standard has three times the weight of the 1940 standard. Since these age groups have very high age-specific death rates, the overall age-adjusted death rate will be higher using the year 2000 standard.

Figure 2 shows the effect of using different standard populations on age-adjusted death rates in Alaska. For comparative purposes

TABLE 1 NUMBER OF DEATHS, AGE-SPECIFIC DEATH RATES, AND PERCENT CHANGE IN AGE-SPECIFIC DEATH RATES: ALASKA 1990 AND 1998

Age Group	Deaths				Age-Specific Rate		Percent Change
	1990		1998		1990	1998	
	N	Percent	N	Percent			
<1	125	5.7%	61	2.4%	1,044.9	609.4	-41.7%
1 - 4	25	1.1%	15	0.6%	56.8	35.8	-36.9%
5 - 14	32	1.5%	31	1.2%	33.9	27.7	-18.1%
15 - 24	122	5.6%	107	4.1%	154.3	130.8	-15.2%
25 - 34	177	8.1%	104	4.0%	155.9	117.6	-24.6%
35 - 44	209	9.6%	227	8.8%	204.0	188.7	-7.5%
45 - 54	224	10.2%	324	12.5%	420.7	361.6	-14.1%
55 - 64	328	15.0%	371	14.3%	1,122.1	905.4	-19.3%
65 - 74	434	19.8%	533	20.6%	2,819.8	2,547.7	-9.7%
75 - 84	338	15.4%	511	19.8%	6,141.0	5,413.1	-11.9%
85+	174	8.0%	302	11.7%	14,500.0	15,672.0	8.1%

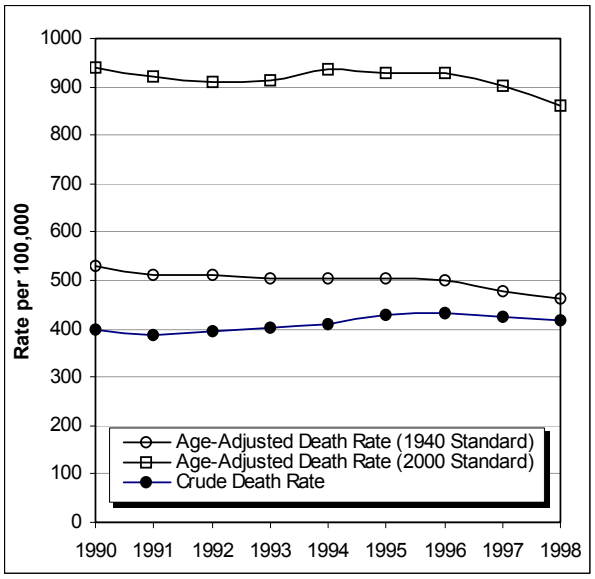

Figure 2. **Crude death rate and age-adjusted death rates for the 1940 and year 2000 standard populations: Alaska 1990-1998.**

the crude death rate is also displayed. As expected, the age-adjusted death rate using the year 2000 standard is almost twice that of the 1940 standard. Observe that the two age-adjusted death rates show the same downward trend, although the 1940 age-adjusted death rate decreased more (12.9%) than the year 2000 rate (8.3%). The crude death rate, which measures the actual rate of mortality in a population, increased by 5.4% during this period.

From 1990 to 1998, there has been a shift in the age distribution of deaths in Alaska (Table 1). In 1990, 68.4% of all deaths occurred to Alaskans ages 45 and older. By 1998, 78.9% of all deaths occurred to Alaskans ages 45 and older. Table 1 shows that age-specific death rates (excepting the over 85 age group) have decreased since 1990, but the decreases were larger for younger age groups. The decrease in the age-specific rates has been mitigated by the increase in deaths to older Alaskans, leading to an increase in the crude death rate.

Causes of Death

Changing standard populations will also affect cause-of-death trends in Alaska, as illustrated in Table 2. For some causes of death, such as accidents, Alzheimer's, HIV, and sui-

TABLE 2. AGE-ADJUSTED DEATH RATES AND PERCENT CHANGE, BASED ON THE 1940 AND YEAR 2000 US STANDARD POPULATIONS FOR SELECTED CAUSES OF DEATH: ALASKA 1990 AND 1998

	Year		Percent
	1990	1998	Change
Accidents (800 - 949)*			
1940	63.5	42.1	-33.7%
2000	69.6	51.6	-25.9%
Alzheimer's Disease (3310)*			
1940	3.0	2.5	-16.7%
2000	6.6	7.4	12.1%
Assault (960 - 978)*			
1940	8.9	7.6	-14.6%
2000	9.9	7.8	-21.2%
Atherosclerosis (440)*			
1940	3.4	2.1	-38.2%
2000	12.9	4.7	-63.6%
Chronic Obstructive Pulmonary Disease (COPD) (490 - 496)*			
1940	26.2	21.5	-17.9%
2000	51.6	43.5	-15.7%
Cerebrovascular Diseases (430 - 438)*			
1940	28.2	26.6	-5.7%
2000	66.6	68.7	3.2%
Chronic Liver Disease and Cirrhosis (571)*			
1940	11.1	8.2	-26.1%
2000	14.7	10.5	-28.6%
Diabetes (250)*			
1940	13.1	12.4	-5.3%
2000	28.6	23.9	-16.4%
Diseases of the Heart (390 - 398, 402, 404 - 429)*			
1940	118.8	100.2	-15.7%
2000	240.2	220.4	-8.2%
HIV (042 - 044)*			
1940	1.8	0.9	-50.0%
2000	1.9	1.0	-47.4%
Suicide (950 - 959)*			
1940	23.3	23.7	1.7%
2000	24.0	22.7	-5.4%
Malignant Neoplasms (140 - 208)*			
1940	126.3	120.5	-4.6%
2000	213.0	202.3	-5.0%
Nephritis (580 - 589)*			
1940	3.5	2.2	-37.1%
2000	8.1	4.7	-42.0%
Pneumonia and Influenza (480 - 487)*			
1940	11.7	9.1	-22.2%
2000	29.7	26.5	-10.8%
Septicemia (038)*			
1940	4.2	2.8	-33.3%
2000	8.4	6.7	-20.2%

***Cause of death codes, based on the Ninth Revision of the International Classification of Diseases**

TABLE 3 AGE-ADJUSTED DEATH RATES BY RACE ALASKA 1990 - 1998

Rate	White Death Rate	Native Death Rate	Mortality Ratio
Age-adjusted Rates			
1940 standard	464.9	743.6	1.6
2000 standard	887.2	1187.8	1.3

cides, there is little difference between the 1940 and year 2000 age-adjusted death rates. These causes of death usually have a risk of death that is uniform across age groups. However for causes of death where the risk of death increases with age, such as chronic obstructive pulmonary disease (COPD) and heart disease, the year 2000 age-adjusted rate is more than twice the 1940 rate.

Additionally, some causes of death will show different trends, depending on which standard is used for age adjusting. Alzheimer's disease and cerebrovascular disease show a decreasing rate of mortality using the 1940 standard and an increasing rate using the year 2000 standard. For suicide the situation is reversed: the year 2000 standard shows a decreasing trend while the 1940 standard shows an increasing trend. For other causes of death, such as diabetes and atherosclerosis, the year 2000 age-adjusted rate shows a much larger decrease than the 1940 rate. Conversely, heart disease deaths, deaths due to pneumonia and influenza, and septicemia deaths show a larger decrease using the 1940 standard.

Mortality Ratios

Changing to the year 2000 standard will also effect mortality ratios by race and sex in Alaska. From 1990 to 1998, the Native 1940 age-adjusted death rate was 1.6 times that of the white population (Table 3). Using the year 2000 standard, the Native age-adjusted death rate is only 1.3 times that of the white population. Changing standard populations increased the white age-adjusted death rate 90.8%, but the Native age-adjusted death rate only increased 59.7%. The white age-adjusted death increased more when changing standards because proportionally more deaths occur to older people in the white population than in the Native population. During this period the median age at death for white population was 65 years, compared with 58 years for the Native population. Deaths over 65 years of age have almost twice the weight in the year 2000 standard as the 1940 standard (.126387 and .068499, respectively).

Age-adjusted mortality ratios can also hide some important differences in age-specific death rates by race (Table 4). For some age groups, Natives have a risk of mortality that is over three times that of whites. Conversely, Natives over the age of 85 have a risk of mortality that is less than that of whites.

A similar situation will occur with the mortality ratio by sex. Using the 1940 standard, the male age-adjusted death rate is 1.6 times that of the female population (Table 5). However when using the year 2000 standard, the male age-adjusted death rate is only 1.4 times that of females. The female age-adjusted death rate nearly doubled when changing standards since proportionally more females die at an older age than males. The median age of all female deaths was 69 years during this period, compared with 60 years for males.

TABLE 4 AGE-SPECIFIC DEATH RATES BY RACE ALASKA 1990 - 1998

Age Group	Age-Specific Rates		Mortality
	White	Native	Ratio
<1	650.1	1,128.6	1.7
1 - 4	32.2	113.9	3.5
5 - 14	21.9	51.3	2.3
15 - 24	110.0	276.4	2.5
25 - 34	115.4	428.0	3.7
35 - 44	162.5	460.8	2.8
45 - 54	321.3	664.4	2.1
55 - 64	938.7	1,534.6	1.6
65 - 74	2,547.4	3,137.7	1.2
75 - 84	5,708.0	7,340.3	1.3
85+	16,714.9	14,311.4	0.9

TABLE 5 AGE-ADJUSTED DEATH RATES BY SEX ALASKA 1990 - 1998

Rate	Female Death Rate	Male Death Rate	Mortality Ratio
Age-adjusted Rates			
1940 standard	381.3	615.4	1.6
2000 standard	755.8	1081.6	1.4

DISCUSSION

As shown in Figure 2, the choice of a standard population does not make much difference when observing trends over time. Both standard populations showed the same general trend during this period. Yet Table 1 showed some problems of using a summary index like an age-adjusted death rate. It is not possible for a single index to reflect different trends in age-specific rates over time. If trends for different age groups are nearly the same, almost any standard population will adequately reflect the overall trend and allow comparisons between different populations. The more the age-specific rates vary over time, the more unsatisfactory a summary measure will be. In cases such as these, analyzing trends in age-specific rates may be the better choice.

The mortality ratio can be used to show the difference in mortality between two groups. As seen in this newsletter, the choice of a standard for age-adjusted will effect the magnitude of the mortality ratio, although the trend in the mortality ratio is usually not effected. However, a mortality ratio, the ratio of age-adjusted rates, can hide important differences in age-specific mortality rates, as seen in Table 4.

The actual rate of mortality in a population, such as Alaska, is measured by the crude death rate. It is important to remember that an age-adjusted rate does not represent the risk of death in a real population. Comparing age-adjusted death rates over time can reflect changes in the average risk of mortality. However, as seen in this newsletter, when age-specific death rates do not have a consistent relationship over time, the age-adjusted death rate may give misleading results. During this transition period, it will be important to make sure when comparing age-adjusted rates that they are based on the same standard population. Age-adjusted rates based on the 1940 standard will need to be recalculated before they can be compared to rates based on the year 2000 standard.

UPCOMING EVENTS

Cause-of-death statistics are based on the underlying cause of death information from the death certificate. The underlying cause is the disease or injury that initiates the chain of events leading to death. Causes of death are classified using provisions of the International Classification of Diseases (ICD). The ICD is revised periodically to reflect advances in medical science and changes in diagnostic terminology. Since 1979, cause-of-death statistics have been based on the ninth revision of the ICD (ICD-9). Beginning in 1999 mortality statistics, however, causes of death will be classified using the tenth revision of ICD (ICD-10).

The only way to compare mortality statistics coded under different revisions of the ICD is to use comparability ratios. Comparability ratios are calculated by taking one year of deaths and coding them twice - once under ICD-9 and once under ICD-10. The Bureau of Vital Statistics is currently working on developing comparability ratios to compare causes of death between ICD-9 and ICD-10. The results of the this study will be previewed in the next Vital Signs Newsletter.

APPENDIX

Age-adjusted death rates are a weighted average of age-specific death rates. An age-specific death rate is the number of deaths for a particiular age group, divided by the population of the same age group. Let

D_i = the number of deaths in age interval i

P_i = the midyear population in age interval i

The age-specific death rate (R_i) is given by

$$R_i = \frac{D_i}{P_i} \times 100{,}000$$

The age-adjusted death rate is given by

$$\sum_i w_i \times R_i$$

where w_i = the standard weight for age group i

To calculate age-adjusted death rates, a standard population must be chosen. The standard population is usually partitioned into 11 age groups, but other age groupings can be used. Table 6 shows the standard weights by age group for both the 1940 and the 2000 standard million populations.

TABLE 6. THE 1940 AND YEAR 2000 US STANDARD POPULATIONS

Age	Standard Weights	
	1940 Standard Million	2000 Standard Million
Under 1 year	0.015343	0.013818
1 - 4 years	0.064718	0.055317
5 - 14 years	0.170355	0.145565
15 - 24 years	0.181677	0.138646
25 - 34 years	0.162066	0.135573
35 - 44 years	0.139237	0.162613
45 - 54 years	0.117811	0.134834
55 - 64 years	0.080294	0.087247
65 - 74 years	0.048426	0.066037
75 - 84 years	0.017303	0.044842
85 years and over	0.002770	0.015508
Total	1.000000	1.000000

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