Analysis of Crude and Age-Adjusted Cancer Death Rates in West Virginia

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A DEATH RATE depends on the living and the dead. Generally, a cause-specific death rate is calculated by dividing the total number of deaths for a particular unit of time by the total population and multiplying by 100,000. The statistic obtained as a result of this calculation indicates how many people would die in each group of 100,000. This death rate, then, is the result of a division process in which the dividend is made up completely of the dead, and the divisor (the total population) is composed of the living.

In the following discussion, we consider the effect that each of these components has on a death rate in general and, in particular, how the makeup of the total population is of great consequence in considering death rates in West Virginia. We then consider in particular, and by illustration, the trends in six major cancer death rates in West Virginia. We hope that this procedure, in addition to shedding light on the cancer situation in West Virginia, will also indicate the usefulness of adjusted rates in making comparisons where it is desirable to limit the effect of variables such as age, sex, and race.

The Death Rate Statistic

Let us take a closer look at the fraction which gives rise to the death rate. To illustrate, we hypothesize two States in the Union in which during a particular year deaths occurred due to some specific disease. In State A, 343 people died of this disease, and State B lost 594 residents to the disease. We now have sufficient information for the numerator of the death rate fraction, but until we obtain information about each State's population we can say little in terms of comparison regarding the two States.

Suppose, then, that State A has a population of 2.3 million while State B has 5.9 million. Now we can calculate the respective cause-specific death rates for States A and B. The computation yields a death rate of 14.91 per 100,000 population per year for State A and a rate of 10.07 per 100,000 per year for State B. Now we are certainly better able to make a comparison between the two States. We can say that although numerically more people died from the disease in State B than in State A, relative to the size of the total population more people are dying in State A.

For purposes of comparison, the cause-specific death rate certainly proves itself superior to the raw count. It is not free from the effects of population distribution, however, since death does not equally attack all age groups in a population. Thus, if one hypothetical State contains a disproportionately large percentage of elderly people

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Table 1. Age distribution for two hypothetical States

Age group (years)	State A Population	State A Percent	State B Population	State B Percent
1–9	423,200	18.4	1,309,800	22.2
10–19	462,300	20.1	1,050,200	17.8
20–29	331,200	14.4	938,100	15.9
30–39	213,900	9.3	826,000	14.0
40–49	271,400	11.8	672,600	11.4
50–59	250,700	10.9	507,400	8.6
60–69	188,600	8.2	359,900	6.1
70 and over	158,700	6.9	236,000	4.0

while the other contains a disproportionately large percentage of young people, the respective death rates will certainly be affected. For a closer look at this, suppose that the age distributions for the two States are as listed in table 1.

In State A, 26 percent of the population is age 50 or over whereas in State B only 18.7 percent of the population is 50 or over. The question that arises is how much of the difference between the respective death rates is attributable to the heavy percentage of older people in State A. We would like to determine whether the rates would be significantly different if it were not for the variance in age distribution between the States.

The statistical technique used to shed light on this question is called age-adjustment. In the direct method of age-adjustment a standard population is selected for use. Specific death rates are then calculated in the normal fashion for each age bracket in each State. These rates are then applied to the appropriate age groups in the standard population, thus yielding the number of deaths which would have occurred in the standard population if the standard population had had the same age-specific death rates as the State in question. The computation for our particular example, where we have selected the population of the United States in 1940 as our standard population, is shown in table 2 for States A and B.

The result of these calculations is a statistic which can be used to compare State A with State B. The advantage in using the age-adjusted death rate over the crude death rate is that the comparison then allows for the variation in age distribu-

Table 2. Computation of age-adjusted rates for States A and B

Age group (years)	Number of deaths		Age-specific death rate		Number in standard population	Deaths in standard population	
	State A	State B	State A	State B		State A	State B
0–29	0	0	0	0	67,990,077	0	0
30–39	4	12	1.87	1.45	19,787,765	370	287
40–49	20	29	7.37	4.31	17,043,068	1,256	735
50–59	56	82	22.34	16.16	13,100,711	2,927	2,117
60–69	78	96	41.36	16.67	8,534,997	3,530	2,276
70 and over	185	375	116.57	158.90	5,212,657	6,076	8,283
Total	343	594	14.91	10.07	131,669,275	14,159	13,698

Age-adjusted rate, State A: $\frac{14{,}159 \times 100{,}000}{131{,}669{,}275} = 10.75$

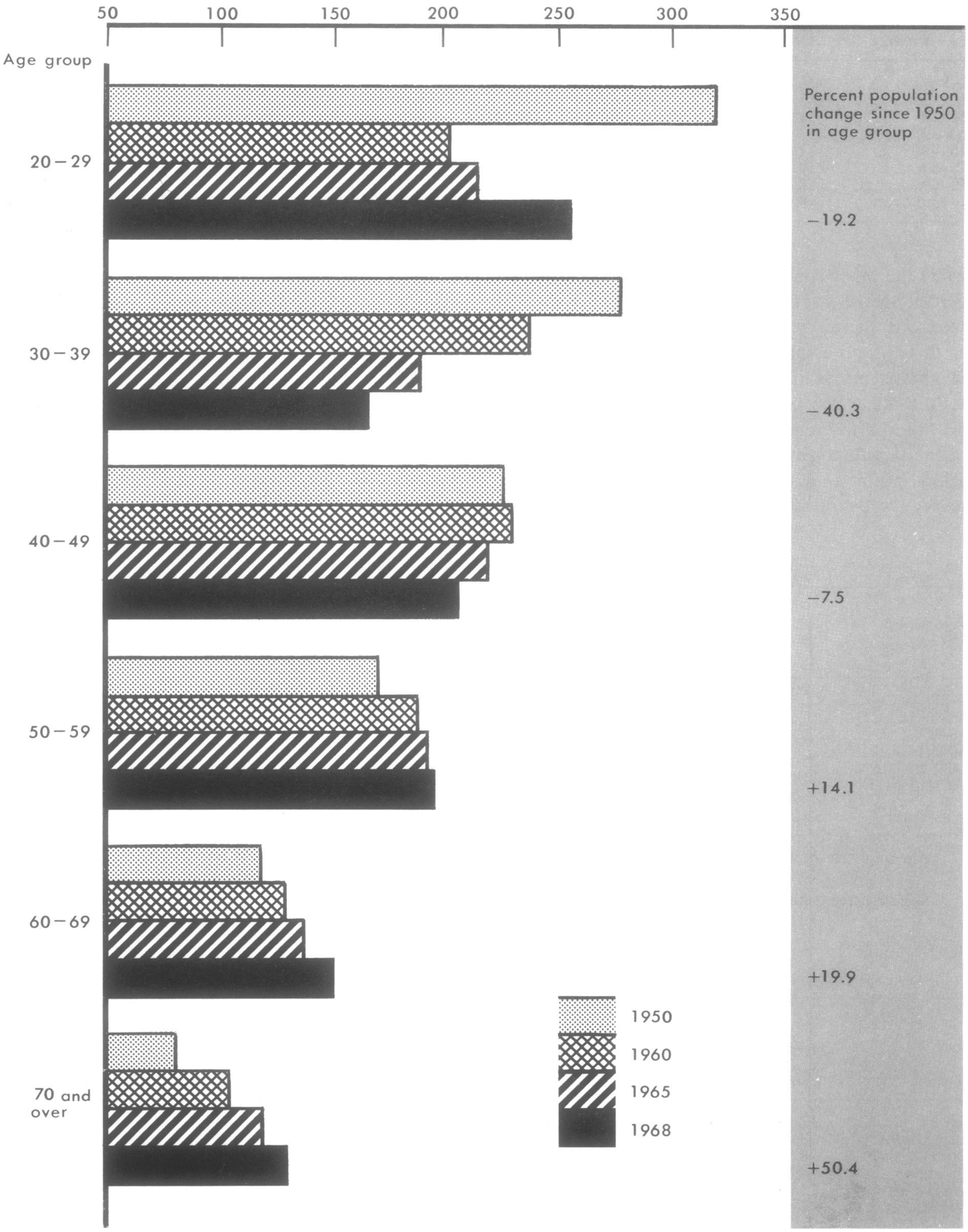
Age-adjusted rate, State B: $\frac{13{,}698 \times 100{,}000}{131{,}669{,}275} = 10.40$

Table 3. Crude and age-adjusted death rates for six selected cancer sites

Site	1950		1960		1965		1968		18-year percent change	
	Crude	Age-adjusted	Crude	Age-adjusted	Crude	Age-adjusted	Crude	Age-adjusted	Crude	Age-adjusted
Breast	17.11	18.62	18.19	16.96	24.49	20.38	23.45	19.15	+37.1	+2.8
Large intestine	10.07	10.51	12.69	10.46	13.42	10.37	14.91	10.78	+48.1	+2.6
Lung	8.98	9.77	19.03	16.90	25.47	21.15	34.39	27.47	+283.0	+181.2
Prostate	13.81	13.72	15.96	12.20	18.04	12.51	20.45	13.68	+48.1	−0.3
Stomach	13.31	13.94	11.77	9.46	9.41	6.99	10.44	7.36	−21.6	−47.2
Uterus	22.52	24.97	19.46	17.72	17.19	15.13	17.81	14.69	−20.1	−41.2

NOTE: Age-adjusted rate computed by direct method using the 1940 U.S. population as standard.

Figure 1. West Virginia population, in thousands, 1950-68



tion in the States compared. Since there is no apparently significant difference in the age-adjusted death rates for States A and B, the difference in the crude rates seems largely due to the fact that State A had an older population than State B.

In the foregoing illustration we used age-adjustment to compare death rates between two different States. The process can also be used to study trends within one State, since the age distribution of a State's population is subject to change during the period of years encompassed by the trend study. We have found this process particularly enlightening in studying trends in West Virginia which has an aging population.

The population chart (fig. 1) shows how the age distribution of the West Virginia population has changed from 1950 through 1968. The three younger age groups showed a net loss during the 18-year period, while the three older groups showed a steady gain during the same period. A rough idea of how this population change will affect trends in cancer death statistics can be obtained by consideration of another population fact. From 1950 through 1968, the overall population of West Virginia decreased 10.68 percent while the portion of the population most subject to death from cancer—those over 45 years of age —showed an 18.8 percent increase.

Cancer Death Rates

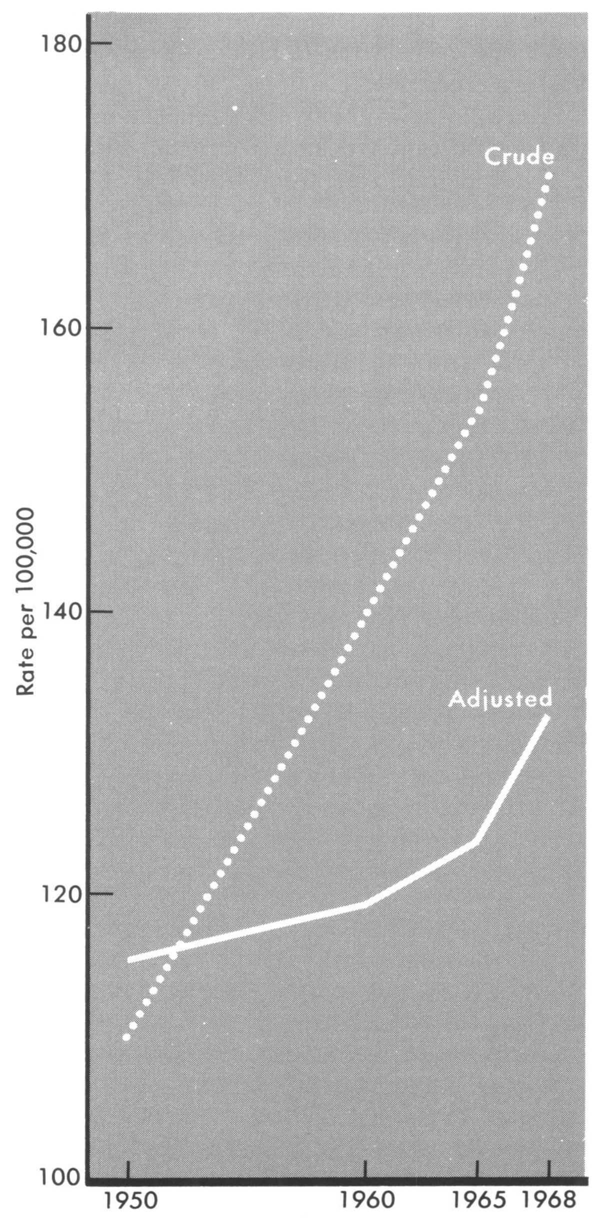
The West Virginia population trend certainly indicates that calculation of age-adjustment death rates might prove beneficial in any attempt to grasp the cancer situation in the State. Table 3 summarizes the crude and age-adjusted death rates for each of six major cancer sites during the 18-year period and includes the percentage of change up or down which the rates showed.

The data in table 3 point up the dramatic rise of lung cancer deaths, with the age-adjusted death rate showing a 181 percent increase during the 18-year period. The difference between the age-adjusted and the crude death rates for lung cancer indicates that the changing age distribution has had its effect on the rate. But the sharp rise in both rates indicates that factors other than age are aggravating the lung cancer situation. Research has, of course, identified cigarette smoking as a major factor in lung cancer.

Table 3 also shows the change which the Papanicolaou test has wrought in the uterine cancer death rate. The benefit of using the age-adjusted rate when considering trends is forcefully demonstrated by the data for uterine cancer between 1965 and 1968. During those 3 years, the crude rate reversed its downward trend, but the fact that the age-adjusted rate continued to decline indicates that the rise in crude rate was due to an increase in the portion of the West Virginia population most subject to uterine cancer.

The death rates for breast cancer fluctuated during the 18 years. However, although the crude

Figure 2. Cancer death rates in West Virginia, all sites



rate showed a 37 percent increase, the age-adjusted rate showed only a small upward change.

Similarly, the death rate for cancer of the large intestine showed a sizable jump in crude rate, while the age-adjusted rate remained almost constant since 1950. Here again, we see the influence of the population change during the 18 years.

The net drop in death rate for stomach cancer over the trend period is consistent with a matching but as yet unexplained national trend.

In West Virginia, 62 percent of the men who died of cancer of the prostate in 1968 were 75 years old or over. Cancer of the prostate takes its greatest toll among the elderly, and this accounts for a 0.3 percent decrease in the age-adjusted death rate even in the face of a 48 percent increase in crude rate.

Figure 2 shows the West Virginia crude and age-adjusted cancer death rates for all sites. The crude death rate rose from 109.45 in 1950 to 169.76 in 1968. This 55 percent increase compares to a 14.3 percent increase in age-adjusted rates, with both increases reflecting the sharp rise in deaths due to cancer of the lung as well as a 34.7 percent rise in the rate of non-lung cancer deaths between 1950 and 1968.

Conclusion

We hope that the presentation of both the crude and adjusted rates for the major causes of death from cancer helps to form a better picture of the cancer situation in West Virginia. However, we are fully aware that although the relative size of the age-adjusted death rates may help us to comprehend more fully the cancer mortality data in West Virginia, these lower rates are hypothetical by construction and do not in reality lower the number of deaths due to cancer, nor in any way lessen the urgency with which the second greatest cause of death must be treated.