atmospheric sciences. Applications might include verifying air-mass trajectories on scales at which they cannot be otherwise verified and evaluating large-scale diffusion. A particularly valuable application of elemental tracers should be in determining the source areas of contaminants in precipitation, which is important in the field of acid deposition.

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$$\text{Noncrustal } X_a = \text{total } X_a - Al_a \left(\frac{X}{Al}\right)_r$$

In most cases, global mean crustal rock or soil is satisfactory; occasionally, local rock or soil must be used as reference material.
6. The dividing line between fine and coarse aerosol is usually taken to be radius ~ 1 μm. This corresponds to the approximate breakpoint between (i) particles which penetrate to the lung and those which do not, (ii) coarser particles formed by mechanical subdivision (of soil and seawater, for example) and finer particles formed by coagulation or nucleation, and (iii) the original German "large' and "giant" ranges of particles.
7. Instrumental neutron activation normally allows As, Sb, Se, Zn, and noncrustal V to be determined in replicate aerosol samples to uncertainties of 5 to 15 percent, and In and noncrustal Mn to 10 to 40 percent. Differences between elements in simultaneous samples are usually less than 10 percent; for ratios, most of this difference disappears.
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23. We thank N. F. Lewis, K. A. Schweitzer, M. A. Voytek, T. R. Fogg, D. L. Smith, and T. J. Conway for technical assistance. Samples were provided by R. Poirot of the Vermont Agency of Environmental Conservation, C. Brosset of the Swedish Water and Air Pollution Research Laboratory, E. Mészáros and A. Mészáros of the Institute for Atmospheric Physics (Budapest), B. Ottar of the Norweigian Institute for Air Research, R. Kartastenpää and K. Markkanen of the Finnish Meteorological Institute, and various observers at the GMCC Baseline Observatory in Barrow, Alaska. Samples were analyzed at the Rhode Island Nuclear Science Center. M. Prager performed the calculations involving higher order discriminant analysis. This work was supported in part by ONR contract N00014-76-C-0435, NSF grant DPP 8020928, NOAA grant NA-80-RA-C-0207, a grant from the Ohio Electric Utilities Institute, and the Edison Electric Institute.

Childhood Leukemia and Fallout from the Nevada Nuclear Tests

Charles E. Land, Frank W. McKay, Stella G. Machado

In 1979 Lyon *et al.* (*1*) reported an association between increased risk of mortality from childhood leukemia and residence in the southern 17 counties of Utah between 1951 and 1958, the major period of aboveground nuclear weapons testing at the Nevada Test Site. They observed different patterns of risk with respect to age and calendar time between children from 17 rural counties in southern Utah, which they designated as the "high-fallout" area on the basis of maps of estimated fallout distribution, and those from the remaining 12 northern counties of Utah, which they called the "low-fallout" area (Fig. 1). Within each of these two geographic areas, the number of leukemia deaths that occurred after 1950 among children born before 1959, the "high-exposure cohort" of Lyon *et al.* (*1*), were compared with those in their so-called "low-exposure cohort"—that is, childhood deaths between 1944 and 1950, before nuclear testing began, and deaths among children born after 1958, when aboveground testing had practically ceased (Fig. 2). The association between fallout and leukemia mortality was indicated by a difference between the standard mortality ratios used to compare the high-exposure and low-exposure cohorts within each area. That is, the ratio of observed deaths in the high-exposure cohort to the number expected on the basis of the observed number in the low-exposure cohort was higher in southern Utah than in northern Utah.

The mortality rate for the high-exposure cohort in southern Utah was not extraordinarily high but was comparable to the corresponding rate in northern Utah. But the rate for the low-exposure cohort, for the period 1944 through 1950 and for children born after 1958, was lower in southern Utah than in northern Utah (Table 1). Presumably, leukemia mortality among children (ages 0 to 14 years) in an area of normally low risk was increased, after their exposure to fallout, to a level comparable to that in the northern part of the state. In contrast, for children born after the testing period, the level of risk was substantially lower, as it had been before testing be-

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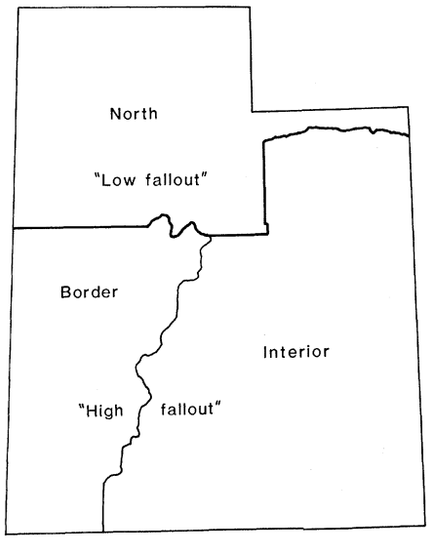

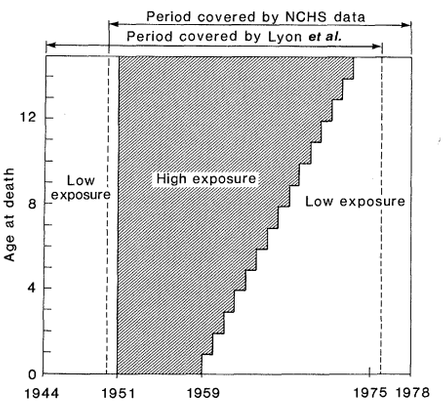

Fig. 1 (left). Geographic regions designated by Lyon *et al.* (*1*, *3*) as experiencing high and low levels of fallout from weapons tests at the Nevada Test Site between 1951 and 1958. Fig. 2 (right). Definition of "high-exposure" and "low-exposure" categories in terms of calendar time and age.

Table 1. Childhood leukemia mortality rates reported by Lyon *et al.* (*1*, *3*) in Utah between 1944 and 1975, by year of birth, year of death, and geographic region. Rates are per 100,000 population per year, directly adjusted for age and sex to the 1960 U.S. white population.

Year of birth	Year of death	Mortality rate	
		Southern Utah	Northern Utah
1958 or earlier	1944 to 1950	2.10	3.84
	1951 to 1972	4.39	4.21
1959 or later	1959 to 1975	1.96	3.28

gan. Although it was not asserted by Lyon *et al.* (*1*) that an etiologic relation had been shown, alternative explanations such as "an unknown factor" that "could have depressed leukemia mortality in the high-fallout counties" before testing began or in children born after 1958, or "a chance clustering of leukemia deaths in a short time," were declared unlikely.

Recently, Beck and Krey (*2*) reported that average exposures to fallout from the 1951 through 1958 test series were, if anything, somewhat higher in northern than in southern Utah. These results indicate that there would be no reason for radiation-induced leukemia to be more frequent in southern than in northern Utah. Thus the Beck and Krey (*2*) report and, if not the results of Lyon *et al.* (*1*), at least the implication of a causal association between fallout and leukemia mortality, are contradictory.

Summary. Cancer mortality data from the National Center for Health Statistics, covering the period 1950 through 1978, were used to test a reported association between childhood leukemia and exposure to radioactive fallout from nuclear weapons tests in Nevada between 1951 and 1958. No pattern of temporal and geographic variation in risk supportive of the reported association was found. Comparison of these results with those presented in support of an association of risk with fallout suggests that the purported association merely reflects an anomalously low leukemia rate in southern Utah during the period 1944 to 1949.

Data Sources and Partitions

The study by Lyon *et al.* (*1*) was based on death certificates obtained from the Utah state registrar of vital statistics. Death certificates from all states, including Utah, are routinely forwarded to the National Center for Health Statistics (NCHS), where they are used to prepare yearly vital statistics reports for the entire country. Yearly listings of cancer deaths, coded as to cause as well as the sex, race (white and nonwhite), and county of residence of the deceased, were available from the NCHS for the period 1950 through 1978, but not earlier.

We attempted to confirm the findings of Lyon *et al.* (*1*) by using childhood cancer mortality data from the NCHS. We also used these data to compare southern Utah with several areas outside Utah that were relatively unaffected by radioactive fallout from the Nevada Test Site, using the same method as that used to compare southern and northern Utah.

We constructed frequency tables for all cancer deaths of children between 1950 and 1978 by cause of death (leukemia or other cancer), age, year, race, and county of residence. These frequencies were consolidated by geographic region and age-time categories as specified by Lyon *et al.* (*1*). The "high-fallout area" of 17 southern counties was subdivided into five border and 12 interior counties (*3*); the "low-fallout area" consisted of the 12 remaining counties in the north (Fig. 1). As shown in Fig. 2, the high-exposure age-time category [the "cohort" of Lyon *et al.* (*1*)] included deaths before age 1 for the years 1951 through 1958, deaths at age 1 for the years 1951 through 1959, and so on up to deaths at age 14 for the years 1951 through 1972. All remaining deaths—that is, all in 1950 and all subsequent to the high-exposure years for each age at death—were assigned to the low-exposure category. The low-exposure category of Lyon *et al.* included the years 1944 through 1949, which were not covered by the NCHS data; on the other hand, the NCHS data include the years 1976 through 1978, which were not covered by Lyon *et al.*

Two more geographic regions were selected for comparison with the Utah regions: eastern Oregon, defined as most of the state east of the crest of the Cascade Range (Klamath County was omitted because it contains a metropolitan area larger than any in southern Utah), and the state of Iowa. Eastern Oregon was selected because it is a rural and largely desert area near Utah that was virtually unaffected by fallout from the Nevada Test Site. Iowa is a more populous but largely rural state and was included to provide a contrast more typical of the United States as a whole. High- and low-exposure age-time categories were defined for eastern Oregon and Iowa in exactly the same way as those for northern and southern Utah.

Regional differences throughout the United States with respect to the ethnic and racial composition of the nonwhite population led us initially to base the comparison solely on mortality among white residents. Later, however, it appeared that several of the leukemia deaths reported by Lyon *et al.* in the southern counties were from the nonwhite population, and it seemed appropriate to include an additional analysis of leukemia mortality based on the combined white and nonwhite populations of the Utah areas.

Person-year values corresponding to

the age-time categories for deaths were obtained from county-specific data in 5-year age intervals (0 to 4, 5 to 9, and 10 to 14 years) from national U.S. Census figures for 1950, 1960, 1970, and (estimated) 1975 (*4–6*) and interpolated linearly by calendar year. Approximate person-year values corresponding to single years of age were estimated as 1/5 the interpolated values for the appropriate 5-year age intervals.

Statistical Comparisons

For each geographic area, a standardized rate ratio was calculated as the (standardized) mortality rate for the high-exposure category divided by the corresponding low-exposure rate. Approximate 90 percent confidence limits were obtained by the Taylor series method applied to the logarithms of the standardized rate ratios (*7*). Standardization was with respect to the age distribution of the 1960 U.S. white population and, for comparisons involving whites and nonwhites, the distribution of whites and nonwhites within Utah. Single-year age strata were used because the high- and low-exposure time periods vary systematically with age at death (Fig. 2), causing the age distribution within any multiyear age stratum to be older for the high-exposure category than for the corresponding low-exposure category. The analysis was not stratified by sex because, although leukemia mortality is known to vary by sex, there is little variation in the population sex ratio among children by geographic region, age, or calendar time. Comparable rates and rate ratios for the United States as a whole were calculated from cancer mortality rates for 5-year age intervals and single calendar years (*8*).

This analysis was supplemented by an age-adjusted contingency table analysis (results not shown), for which an internal standard of adjustment was used (*9*). Although the contingency table analysis gave results very similar to those obtained by the standardized rate ratio method, the latter approach was preferred because it is more straightforward to compare ratios obtained by using the same standard age distribution.

Table 2. Childhood leukemia deaths between 1950 and 1978 by age, geographic region, "exposure" category, and race (Utah only, with nonwhite values in parentheses).

Age	Leukemia deaths									
	Southern Utah (border)		Southern Utah (interior)		Northern Utah		Eastern Oregon		Iowa	
	High exposure	Low exposure	High exposure	Low exposure	High exposure	Low exposure	High exposure	Low exposure	High exposure	Low exposure
0	0	1	1	0	4	9	1	1	14	23
1	0	0	0	0	2	13	2	2	19	24
2	1	0	1	1	10	14	3	4	28	30
3	0	0	2 (1)	1	22	15	1	0	38	49
4	2	1	1	2	17	13 (1)	4	2	50	52
5	0	1	1	0	12	14	3	3	35	30
6	0	0	1 (1)	1 (1)	10	16	1	0	30	26
7	1	0	1	3	11	18	0	0	40	30
8	1	1	1	0	10	4	6	2	29	21
9	1	2	1	0	7	3 (1)	1	0	31	18
10	1	0	0	0	9	1	3	1	25	10
11	1	1	2	0	7	3	1	0	17	10
12	1	0	1	0	19	3	2	0	22	10
13	1	0	1	0	2 (1)	1	0	0	22	6
14	3	0	3	1	8	0	0	1	15	9
Total	13	7	17 (2)	9 (1)	150 (1)	127 (2)	28	16	415	348

Table 3. Estimated person-years at observation for risk of leukemia between 1950 and 1978 by age, geographic region, "exposure" category, and race (Utah only, with nonwhite values in parentheses).

Age	Person-years (in hundreds)									
	Southern Utah (border)		Southern Utah (interior)		Northern Utah		Eastern Oregon		Iowa	
	High exposure	Low exposure	High exposure	Low exposure	High exposure	Low exposure	High exposure	Low exposure	High exposure	Low exposure
0	82 (1)	201 (5)	193 (13)	411 (44)	1,421 (20)	4,450 (82)	345	745	4,628	10,092
1	92 (1)	191 (5)	217 (15)	387 (42)	1,629 (23)	4,242 (79)	388	701	5,229	9,491
2	101 (1)	182 (4)	240 (17)	364 (40)	1,844 (26)	4,028 (76)	431	658	5,835	8,885
3	110 (1)	173 (4)	262 (19)	341 (38)	2,056 (30)	3,815 (73)	473	616	6,426	8,294
4	119 (2)	164 (4)	283 (21)	320 (36)	2,267 (33)	3,605 (69)	514	576	7,002	7,717
5	126 (1)	137 (3)	283 (18)	292 (35)	2,153 (31)	3,052 (58)	535	593	6,905	7,980
6	136 (2)	128 (3)	303 (20)	272 (33)	2,348 (34)	2,857 (54)	577	551	7,471	7,414
7	145 (2)	118 (2)	323 (22)	252 (31)	2,545 (38)	2,660 (51)	619	510	8,034	6,851
8	154 (2)	110 (2)	342 (24)	233 (29)	2,743 (41)	2,462 (47)	659	469	8,595	6,291
9	163 (2)	101 (2)	360 (26)	215 (27)	2,942 (45)	2,263 (44)	700	429	9,153	5,733
10	157 (2)	100 (2)	362 (22)	220 (25)	2,734 (47)	2,202 (46)	688	456	8,925	5,964
11	166 (2)	90 (2)	381 (24)	200 (23)	2,940 (51)	1,996 (42)	730	414	9,496	5,393
12	175 (3)	81 (1)	401 (26)	181 (21)	3,147 (55)	1,789 (37)	773	371	10,064	4,825
13	184 (3)	72 (1)	421 (28)	161 (19)	3,355 (60)	1,580 (33)	816	328	10,628	4,260
14	193 (3)	63 (1)	440 (31)	141 (16)	3,565 (64)	1,371 (29)	858	285	11,190	3,699
Total	2,103 (27)	1,911 (41)	4,810 (324)	3,990 (461)	37,688 (599)	42,370 (819)	9,107	7,704	119,581	102,888

Table 4. Comparison of NCHS data and studies of Lyon *et al.* (*1, 3*) for numbers of childhood leukemia deaths in Utah between 1944 and 1978, by year of birth, year of death, and geographic region.

Year of birth	Year of death	Number of deaths			
		Southern Utah		Northern Utah	
		Lyon	NCHS	Lyon	NCHS
1958 or earlier	1944 to 1949	3+		38*	
	1950	4+	4	6*	6
	1951 to 1972	32	32	152	151
1959 or later	1959 to 1975	10	9	112	105
	1976 to 1978		4		18

*Agreement with NCHS assumed for 1950.

Table 5. Childhood leukemia mortality among whites, 1950 through 1978, with the "high-exposure" category compared to the "low-exposure" category by geographic region and adjusted for age.

Region	Number of deaths		Mortality rate*		Standardized rate ratio†	90 Percent confidence interval
	High exposure	Low exposure	High exposure	Low exposure		
Utah						
Southern						
Border	13	7	5.46	3.83	1.42	0.64, 3.15
Interior	17	9	3.51	2.26	1.55	0.77, 3.12
Total	30	16	4.10	2.76	1.49	0.88, 2.51
Northern	150	127	4.25	2.79	1.52	1.24, 1.87
Eastern Oregon	28	16	3.52	1.94	1.81	1.07, 3.07
Iowa	415	348	3.79	3.28	1.16	1.02, 1.31
United States			3.99	2.96	1.35	1.13, 1.61

*Rates are deaths per 100,000 per year, standardized to the age distribution of the 1960 U.S. white population. †The standardized rate ratio is the high-exposure rate divided by the low-exposure rate.

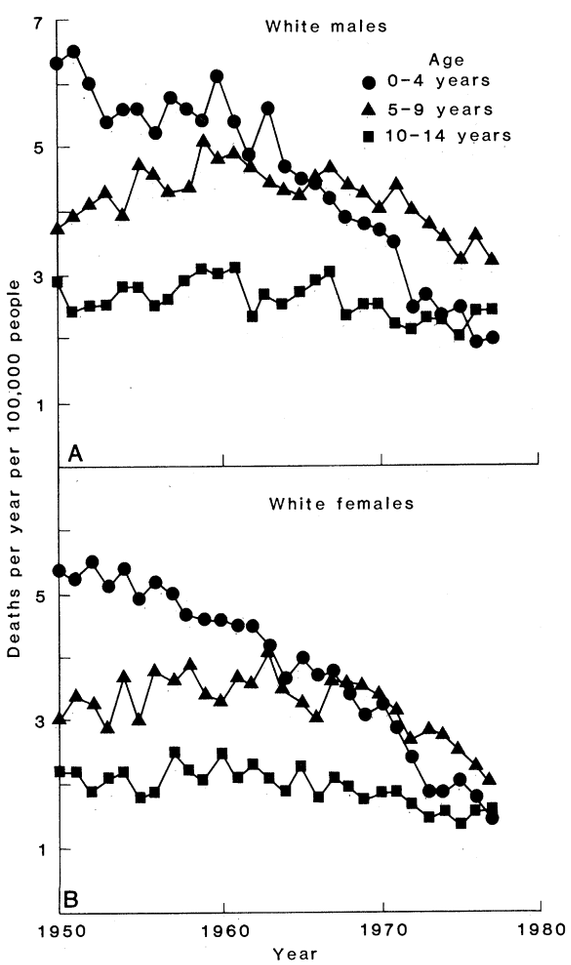

Fig. 3. Temporal patterns in childhood leukemia mortality, United States, 1950 to 1977, by age and sex (*8*).

Mortality: Leukemia and Other Cancers

Most analyses described here can be recreated from the numbers of childhood leukemia deaths and estimated person-years given in Tables 2 and 3.

When Utah leukemia deaths were compared with those reported by Lyon *et al.* (*1*), a reasonable agreement was obtained for the years covered by both studies (Table 4). Standardized rate ratios for the white populations of all areas considered (Table 5) and for Utah whites and nonwhites combined (Table 6), show that, although all the ratios exceeded unity, there were no statistically significant differences in mortality figures between northern and southern Utah; within southern Utah, the small observed difference between the border and interior counties was opposite in direction to that reported by Lyon *et al.* (*3*). The rate ratio for eastern Oregon was (nonsignificantly) larger than that for any of the Utah regions, while that for Iowa was (again, nonsignificantly) less than that for any of the western areas. The rate ratio for the United States as a whole fell between that for Iowa and those for the western areas. These results are consistent with a downward trend over time in childhood leukemia mortality—a trend apparent in all geographic areas covered in our analysis and characteristic of the United States as a whole (*8*) (Fig. 3).

Results for childhood cancer other than leukemia among whites (Table 7), as with leukemia, showed no statistically significant differences by geographic area suggestive of increased risk associated with exposure to fallout in southern Utah. The data clearly suggest a decreasing temporal trend in mortality for most of these areas, if not for the United States as a whole. The most striking finding was a high rate ratio for eastern Oregon, for which no explanation in terms of fallout exposure seems possible.

Discussion

Clearly, the NCHS data provide no support for the conclusion of Lyon *et al.* (*1, 3*) that increased mortality from childhood leukemia was associated with residence in southern Utah during the period of aboveground atomic weapons testing at the Nevada Test Site.

There is much to criticize in their statistical approach, but the differences between their results and ours do not for the most part depend on differences in methodology. The most important methodological criticism is that Lyon *et al.* did not in fact find a statistically signifi-

cant difference in standardized mortality ratios between northern and southern Utah by an appropriate method: a Mantel-Haenszel comparison was not statistically significant (*3*), and the statistically significant difference that was reported in 1979 (*1*) resulted from the use of a method that incorrectly assumed known expected frequencies for the high-exposure categories. The Bailar-Ederer method (*10*) used by Lyon *et al.* (*3*) tests the ratio of two Poisson variates after scaling by an arbitrary constant, such as the ratio of two (known) expected frequencies. This method would be appropriate, for example, for testing two standardized mortality ratios each defined as the ratio of the number of childhood leukemia deaths in the high-exposure category for a given geographical area to the corresponding number expected according to U.S. population rates. The standardized mortality ratios compared by Lyon *et al.* (*1, 3*) were each defined as the ratio of the leukemia frequency in the high-exposure category to the expected frequency estimated from the observed leukemia deaths in the corresponding low-exposure category. Since each (estimated) expected frequency was subject to fully as much random variation as the corresponding observed frequency, a test incorporating the assumption of constant expected frequencies was clearly inappropriate.

Regardless of their appropriateness, the methods used by Lyon *et al.*, like those that we used, fail to discriminate between northern and southern Utah when applied to the NCHS data for 1950 through 1978: standardized mortality ratios comparing high- and low-exposure mortality, computed by their method, were 1.61 for northern Utah and 1.58 for southern Utah (all races). The difference between the two is extremely small and in the opposite direction to that found in the original study of Lyon *et al.* (*1*).

Since the NCHS data agreed reasonably well with those used by Lyon *et al.* (*1, 3*) for the high-exposure categories in both northern and southern Utah, and their statistical methods gave approximately the same result with the NCHS data as the methods that we used, the difference between the two studies must depend on the different low-exposure groups used. Deleting the years 1976 through 1978 from the NCHS data did not change the standardized rate ratios in Tables 5 and 6 enough to suggest a difference between northern and southern Utah. On the other hand, Table 4 indicates that between 1944 and 1949 there were only three childhood leukemia deaths in southern Utah and 38 in northern Utah, a remarkable discrepancy even given the difference in population size.

Figure 4 presents standardized rate ratios comparing southern and northern Utah for each of the five consecutive calendar time-birth cohort divisions shown in Fig. 2: 1944 to 1949, 1950, the high-exposure categories (1951 to 1972 and born in 1958 or earlier), and, for persons born after 1958, the time intervals 1959 to 1975 and 1976 to 1978. Unlike the ratios in Tables 5 through 7, the ratios in Fig. 4 represent comparisons between geographic regions within age-time categories rather than compari-

Table 6. Childhood leukemia mortality in Utah, all races, 1950 through 1978, with the "high-exposure" category compared to the "low-exposure" category by geographic region and adjusted for age and race.

Region of Utah	Number of deaths		Mortality rate*		Standardized rate ratio†	90 Percent confidence interval
	High exposure	Low exposure	High exposure	Low exposure		
Southern						
Border	13	7	5.33	3.74	1.42	0.64, 3.15
Interior	19	10	3.60	2.26	1.60	0.81, 3.15
Total	32	17	4.16	2.74	1.52	0.91, 2.55
Northern	151	129	4.17	2.78	1.50	1.23, 1.84

*Rates are deaths per 100,000 per year, standardized to the 1960 U.S. population age distribution and to the distribution of whites and nonwhites in Utah between 1950 and 1978. †The standardized rate ratio is the high-exposure rate divided by the low-exposure rate.

Table 7. Mortality from childhood cancers other than leukemia among whites, 1950 through 1978, with the "high-exposure" category compared to the "low-exposure" category by geographic region and adjusted for ages.

Region	Number of deaths		Mortality rate*		Standardized rate ratio†	90 Percent confidence interval
	High exposure	Low exposure	High exposure	Low exposure		
Utah						
Southern						
Border	9	10	4.93	6.17	0.80	0.36, 1.77
Interior	18	15	4.65	3.40	1.37	0.75, 2.48
Total	27	25	4.74	4.26	1.11	0.69, 1.79
Northern	173	141	4.90	3.13	1.56	1.29, 1.90
Eastern Oregon	63	22	7.90	2.88	2.74	1.80, 4.17
Iowa	508	388	4.53	3.68	1.23	1.10, 1.38
United States			4.47	4.22	1.06	0.90, 1.24

*Rates are deaths per 100,000 per year, standardized to the age distribution of the 1960 U.S. white population. †The standardized rate ratio is the high-exposure rate divided by the low-exposure rate.

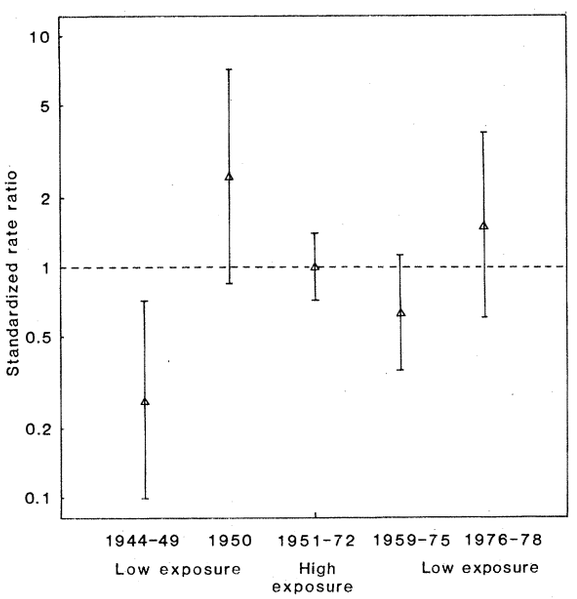

Fig. 4. Childhood leukemia mortality in northern Utah compared with southern Utah: standardized rate ratios and approximate 90 percent confidence intervals, by calendar time and "exposure" category.

sons by age-time categories within geographic regions. The data for 1944 to 1949 were derived from 1944 to 1950 figures stratified by 5-year age intervals (*11*) and with assumed agreement with the NCHS data for 1950.

The pattern of rate ratios does not suggest a relative increase in risk among southern Utah residents after 1950, followed by a return to a previously low level of risk, although it is easy to see how such an interpretation might be considered plausible with only ratios for 1944 to 1950, the high-exposure category and the remaining low-exposure data through 1975 available. The five ratios in Fig. 4 are markedly nonhomogeneous. A statistical test based on the logarithms of these ratios and their standard errors gave a nonhomogeneity chi-square of 8.7 with 4 degrees of freedom ($P = 0.069$). It is the 1944 to 1949 ratio, however, and not the high-exposure value, that seems out of place: chi-square was 8.1 with 3 degrees of freedom ($P = 0.044$) without the high-exposure point, but only 4.1 with 3 degrees of freedom ($P = 0.25$) without the 1944 to 1949 value.

It is apparent that the reported association between childhood leukemia mortality and residence in southern Utah during the years of aboveground nuclear weapons testing at the Nevada Test Site cannot be supported on the basis of mortality data since 1950, but depends rather on the assumption that the extraordinarily low rate observed in southern Utah between 1944 and 1949 is an accurate representation of the true population risk during that period.

A more likely, but nevertheless speculative, suggestion is that the early leukemia deficit was an anomaly related to underdiagnosis of leukemia or to competing mortality from other childhood diseases. Enstrom (*12*) reported that in 1950 there was only one Board-certified physician for a population of about 125,000 in the 17 southern counties of Utah, six in 1961, and four in 1969, whereas in 1961 there were 345 for a northern Utah population of 765,000. The attribution by Lyon *et al.* (*3*) of a relative excess of nonleukemia cancer in the southern counties, before testing began, to miscoded benign tumor deaths (*3*) is itself an indication that case finding and diagnostic accuracy may have improved substantially over time in southern Utah. Kneale and Stewart (*13*) have commented on the increase in reported deaths from childhood leukemia in the United Kingdom that followed the postwar introduction of antibiotics for the treatment of infectious disease, which was often fatal for children whose immune systems were weakened by (often still undiagnosed) leukemia. The difficulties of transportation in areas of low population density, like southern Utah, were much greater in the 1940's than they are now, and this surely had an influence on access to medical services. The similarity between northern and southern Utah with respect to childhood leukemia mortality among children born after 1958 also suggests that it is the experience before 1950, rather than subsequently, that requires explanation.

By themselves, the present comparison of northern and southern Utah, and the findings of Beck and Krey (*2*) with respect to the distribution of fallout within Utah, do not preclude a temporary increase in childhood leukemia risk shared by residents of northern and southern Utah. On the other hand, the very similar result obtained for eastern Oregon, which was virtually unaffected by fallout, suggests that if fallout from the Nevada Test Site did influence leukemia rates over the past 30 years or so, that influence was small relative to the effects of other factors.

The caution expressed by Lyon *et al.* in their original article (*1*) and the caveats given in the accompanying editorial (*14*) were well taken. The evidence for an increase in childhood leukemia mortality in southern Utah as a result of exposure to radioactive fallout between 1950 and 1958 appears, on closer examination of available data, to be slight or nonexistent.

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