GEOGRAPHIC VARIATION IN INCIDENCE OF SKIN CANCER IN THE UNITED STATES

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THE LITERATURE supporting a relationship between exposure to ultraviolet rays and skin cancer is reviewed by Blum (*1,2*). Variations in human skin cancer incidence rates with differences in latitude in the United States were shown by Dorn (*3*), who used data collected from 10 large metropolitan areas in 1937–38. For white males and females in three separate latitude areas, the study showed an inverse relationship between incidence of skin cancer and distance from the equator, that is, the closer the area is to the equator, the higher the incidence.

The National Cancer Institute of the National Institutes of Health, Public Health Service, repeated the survey of the 10 cities during the years 1947 and 1948. This survey provided data on the incidence of skin cancer by age, sex, and color in each of the cities (*4–13*). The present study used these data to determine a more precise relationship between latitude and skin cancer incidence by age and sex.

The incidence rates for the total white male and the total white female populations were age adjusted (U.S. population, 1950) to correct for differences in the age distributions of the populations of the 10 cities. The age-adjusted rates, together with the latitudes of the cities, are given in table 1. In figure 1 these data are plotted on a semilogarithmic scale with least-squares-fitted straight lines drawn to indicate the relationship between latitude and skin cancer incidence rates. The slopes of the two lines are not significantly different, but at any latitude the rates for white males are higher than those for white females.

Age-specific incidence rates for the white male and white female populations in the 10 cities studied are shown in tables 2 and 3. In figure 2, these data are plotted semilogarithmically against the latitudes of the cities, and straight lines are fitted to the plots. No significant difference exists between the slopes of any of the lines. The data for the age group 75 years and older are not plotted since the groups in the various cities are dissimilar. The data for the age groups under 25 years are not plotted because the incidence rates are low and show marked variations. The broken line in the chart for females (aged 55–64 years) rep-

Table 1. Geographic latitude and skin cancer incidence rates per 100,000 population [1] for white males and females, 10 cities of the United States, 1947 or 1948

City	North latitude (degrees)	Incidence rate	
		White male	White female
New Orleans	29. 95	123. 2	68. 7
Dallas	32. 78	164. 4	95. 6
Birmingham	33. 35	182. 2	132. 3
Atlanta	33. 75	110. 0	82. 9
San Francisco	37. 77	97. 1	68. 0
Denver	39. 73	86. 3	60. 6
Philadelphia	39. 95	41. 3	32. 8
Pittsburgh	40. 43	43. 0	32. 5
Chicago	41. 87	25. 3	22. 4
Detroit	42. 33	33. 6	24. 2

[1] Rates are age adjusted.

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resents a correction for what seemed to be an incorrect point. In the reported data the incidence rate for white females aged 55–64 years in New Orleans was less than the incidence rate for white females aged 45–54 years. Such a decrease was not noted in any other age group, male or female, in any other city. The broken line was obtained by omitting this point.

The parallelism of these fitted lines indicates a constant rate of increase in the incidence of skin cancer with decreasing latitude; that is, in the white population, skin cancer rates become higher as one draws closer to the equator. This constant rate of increase appears to be independent of age or sex since all the lines, whether for males or females, are of similar slope. From

Figure 1. Age-adjusted skin cancer incidence rates for white males and females by degrees of north latitude, 10 cities of the United States, 1947 or 1948

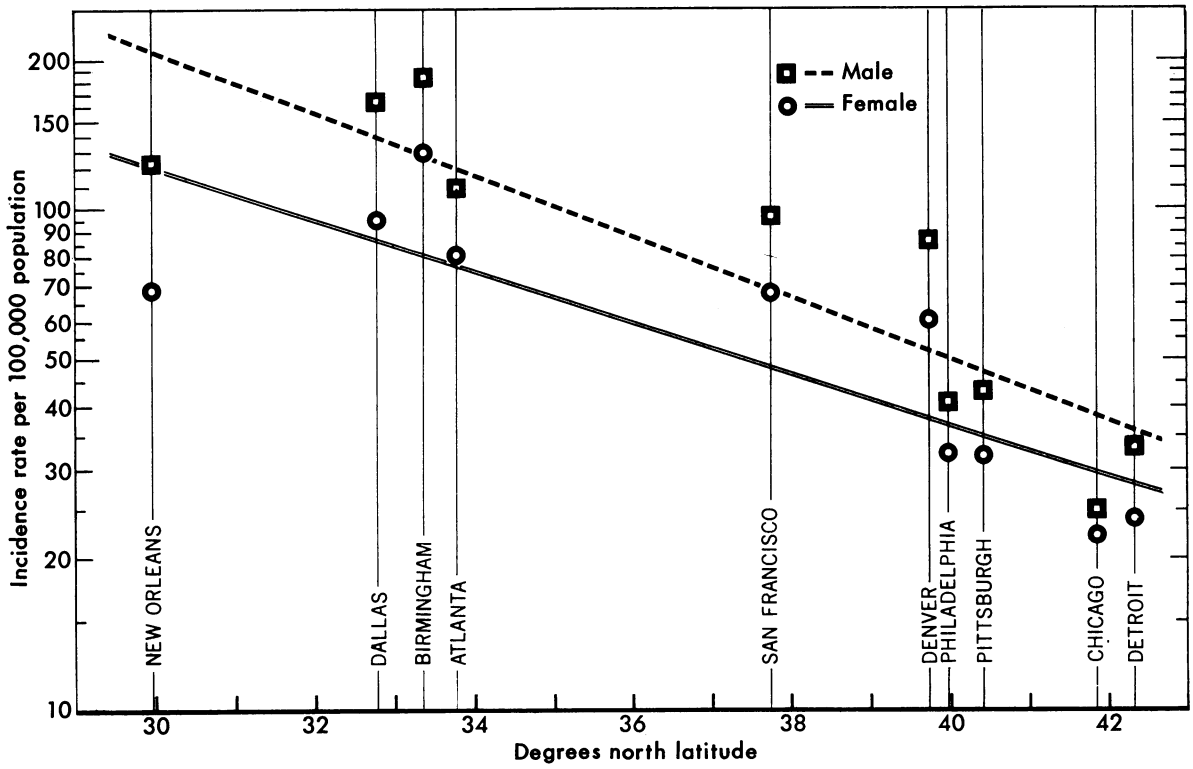


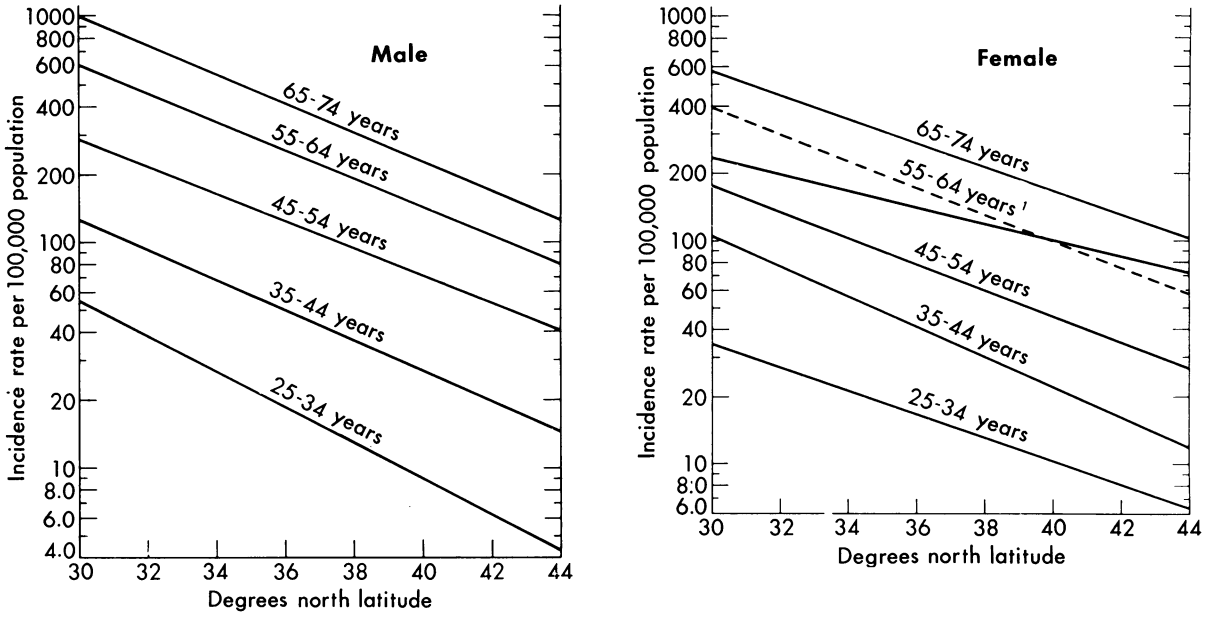
Table 2. Skin cancer incidence rates per 100,000 population for white males, by age group, 10 cities of the United States, 1947 or 1948

City	Age group (years)								Total
	0–14	15–24	25–34	35–44	45–54	55–64	65–74	75 and over	
New Orleans	7.2	3.6	40.7	52.6	139.4	456.7	568.5	704.0	111.8
Dallas	0	11.9	66.7	106.2	253.5	472.4	725.7	985.0	138.1
Birmingham	0	0	17.7	98.5	314.4	552.2	904.4	1,142.1	149.0
Atlanta	0	2.3	22.5	76.3	151.4	259.4	616.8	803.9	86.2
San Francisco	0	4.6	20.5	56.9	137.8	239.0	438.6	938.2	108.5
Denver	1.6	2.8	16.5	48.0	131.7	288.6	371.2	558.8	85.3
Philadelphia	0	2.5	8.9	25.8	56.0	94.7	194.1	405.1	42.7
Pittsburgh	1.8	1.0	8.8	21.9	50.1	136.9	168.1	417.1	41.3
Chicago	0	1.1	4.3	13.2	58.0	68.2	114.2	226.9	25.3
Detroit	.8	1.4	4.0	17.3	44.6	105.9	146.9	287.2	30.1

the fitted lines it can be estimated that skin cancer incidence rates in the white population of the United States are doubled for each 3°48′ of latitude, or approximately 265 miles. In the absence of exact measurements of the amount of ultraviolet energy arriving at the earth's surface in each of these cities, Blum (*2*) has shown that the total energy of solar radiation received at points in the United States increases at a constant rate with decreasing north latitude, that is, the farther south the area, the greater the energy received. The displacement of the plotted points from the fitted line may be due to lesser variables such as altitude, skin susceptibility due to ethnic background of the populations, degree of air pollution, and variations in diagnosis and reporting.

The differences in male and female incidence rates may be explained by differences in amount of exposure to ultraviolet radiation. Above age 35 years the male rates are invariably higher than the female rates. Such increases in male

Figure 2. Age-specific skin cancer incidence rates for white males and females by degrees of north latitude, 10 cities of the United States, 1947 or 1948



[1] Corrected for apparently inaccurate figure for New Orleans.

Table 3. Skin cancer incidence rates per 100,000 population for white females, by age group, 10 cities of the United States, 1947 or 1948

City	Age group (years)								Total
	0–14	15–24	25–34	35–44	45–54	55–64	65–74	75 and over	
New Orleans	0	0	29. 8	67. 9	111. 1	108. 2	267. 0	534. 3	70. 7
Dallas	0	12. 5	29. 0	63. 7	137. 5	186. 1	492. 8	609. 2	82. 5
Birmingham	4. 5	14. 0	19. 7	92. 7	147. 4	315. 3	624. 7	1, 018. 9	108. 9
Atlanta	0	4. 4	17. 6	56. 3	92. 0	214. 1	452. 0	494. 5	70. 5
San Francisco	1. 7	8. 2	25. 1	54. 6	96. 0	174. 9	278. 8	374. 3	79. 1
Denver	1. 7	10. 6	18. 0	32. 4	64. 2	206. 4	219. 5	403. 6	61. 6
Philadelphia	1. 1	3. 2	7. 6	14. 4	46. 3	77. 3	157. 3	240. 6	36. 1
Pittsburgh	1. 9	. 9	10. 8	21. 2	49. 0	73. 2	125. 3	251. 1	30. 7
Chicago	. 5	. 4	5. 7	10. 7	25. 4	65. 7	94. 1	179. 8	22. 1
Detroit	1. 6	1. 3	6. 5	14. 9	21. 2	60. 9	120. 1	182. 1	20. 1

rates over female rates have been explained by Dorn (*14*) and Katz and co-workers (*15*) as due to increased exposure to sunlight or other environmental causes. Below age 35 years, however, the male rates may be higher than, equal to, or lower than the comparable female rates. This finding may reflect increased exposure to sun for girls and women as a result of changes in modes of dress and increased employment outside the home in the last 20 years.

Summary

The relationship between exposure to sunlight and the production of skin cancer is well known. From data available for 10 cities in the United States, a quantitative inverse relationship can be shown between skin cancer incidence rates for the white population and the degree of latitude of the cities.

A constant rate of increase in skin cancer incidence is observed as white populations farther south in the United States are studied. The same rate of increase of skin cancer with decreasing latitude is shown for white male and female populations and for each 10-year age group from 25 through 64 years. The incidence rate is doubled for each 3°48′ of latitude (approximately 265 miles).

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