

BRIEF COMMUNICATION

Non-Hodgkin's Lymphoma and Sunlight

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Incidence and mortality rates for non-Hodgkin's lymphoma (NHL) continue to rise dramatically throughout the world (1,2). Changes in diagnostic practices and in levels of exposure to the established risk factors for NHL (including genetic predisposition, immunosuppression, infection with human immunodeficiency virus [HIV], and various occupational exposures) cannot account for the long-term, worldwide increases (3). On the basis of epidemiologic and experimental observations, some investigators (4,5) recently suggested that sunlight may contribute to the development of NHL and its upward trend. In particular, the rise in NHL incidence parallels the global rise in melanoma incidence (6), patients with NHL are at an elevated risk of developing melanoma (7-10), and experimental data show immunosuppressive effects of UV radiation that may predispose to melanoma or other cancers (11).

The hypothesis that sunlight exposure may affect NHL risk (4,5,10) prompted us to review the geographic patterns of mortality rates in the United States for the following three decades: 1950-1959, 1960-1969, and 1970-1980 (12). In white men and white women, NHL mortality was consistently lower in the southern half of the United States, particularly during the earliest period. In contrast, mortality from melanoma of the skin and nonmelanoma skin cancer

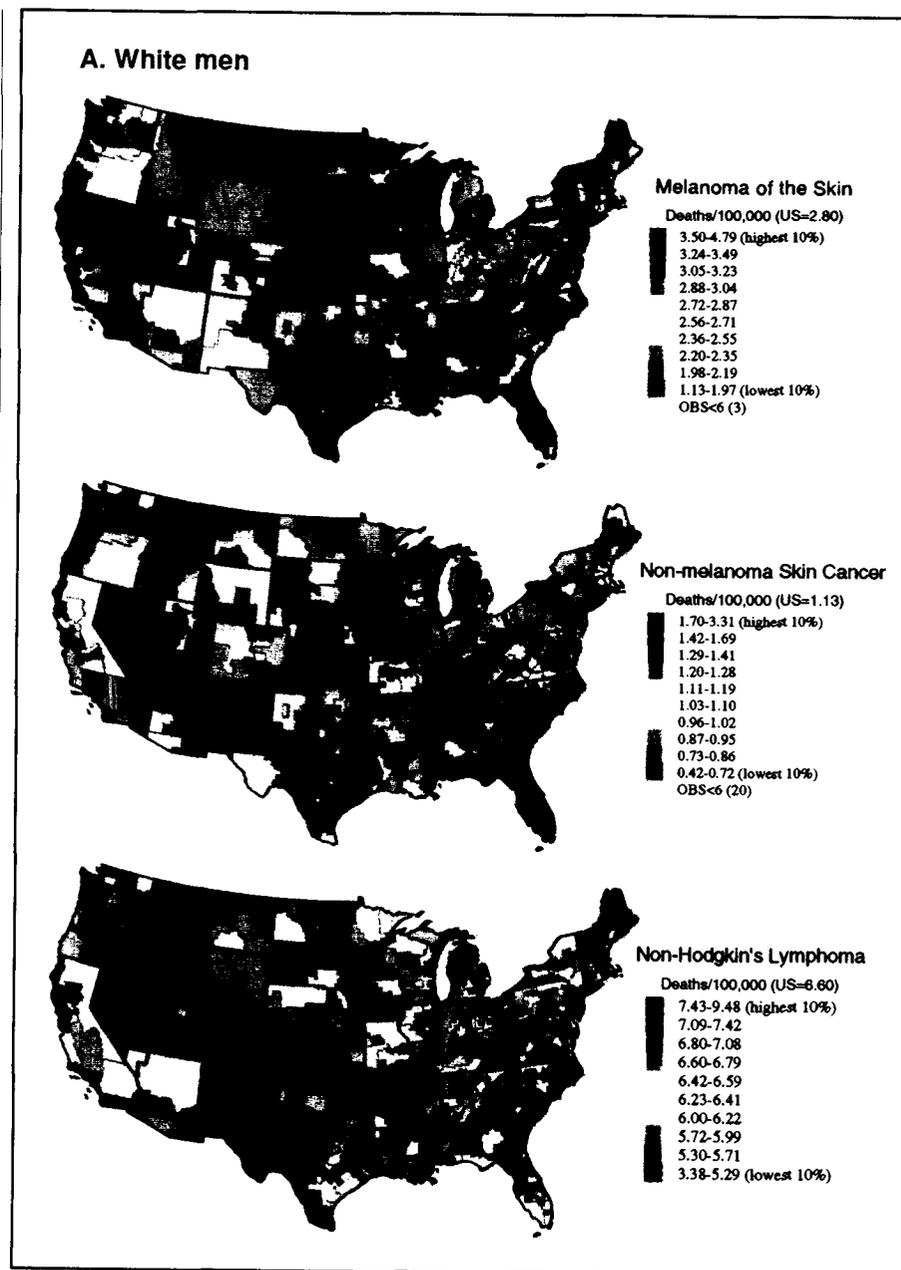


Fig. 1, A. White men. Mortality rates for melanoma of the skin, nonmelanoma skin cancer, and non-Hodgkin's lymphoma (per 100 000 person-years, age-adjusted, 1970 U.S. population), 1970-1989, by state economic area. OBS = observed.

was highest in the South during all three decades.

To evaluate the latitudinal gradients in more recent years, we prepared maps based on mortality rates for state economic areas during the period 1970-1989 for melanoma of the skin, non-melanoma skin cancer, and NHL (National Center for Health Statistics, Hyattsville, MD: unpublished data). State economic areas are individual counties or groups of contiguous counties having similar demographic composition. We examined rates in the

white population because melanoma and nonmelanoma skin cancers are rare in other populations in the United States. Mortality rates varied enough

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See "Notes" section following "References."

B. White women

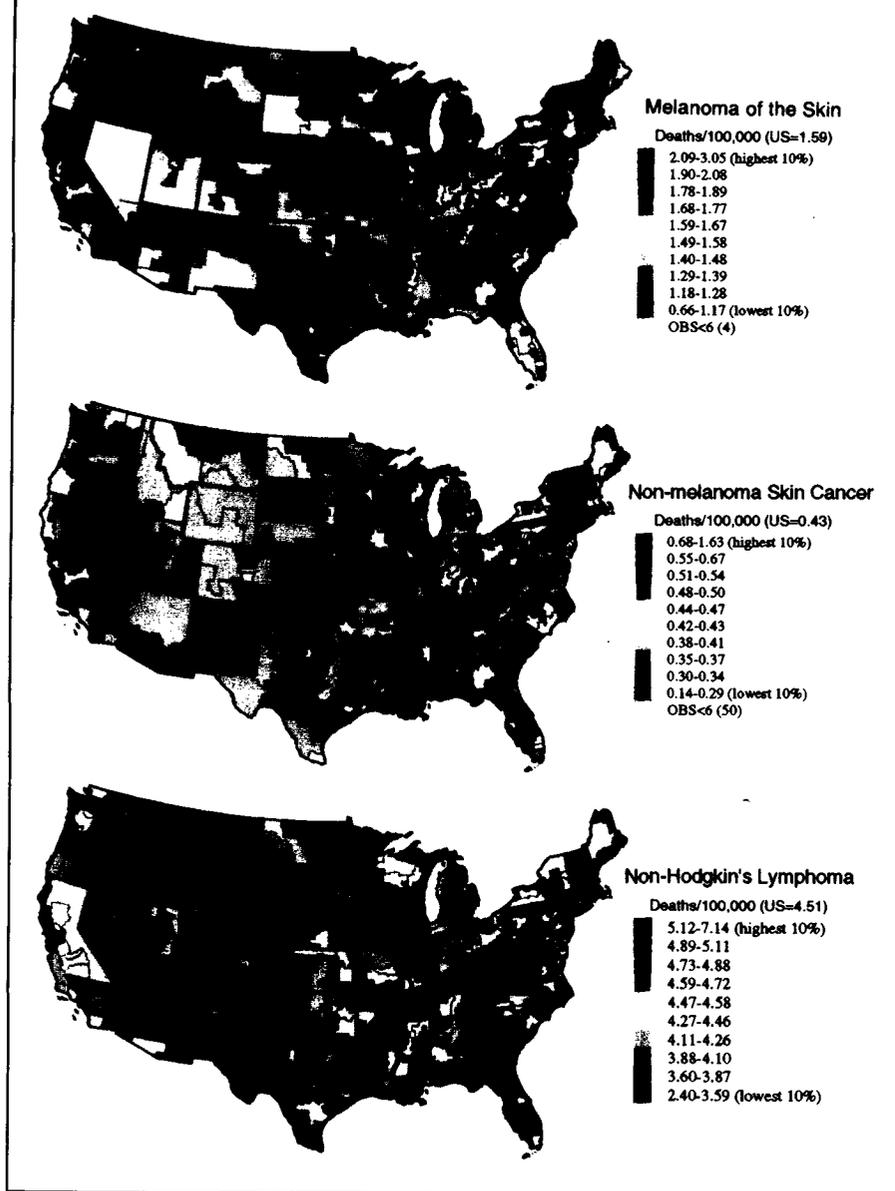


Fig. 1. B. White women. Mortality rates for melanoma of the skin, nonmelanoma skin cancer, and non-Hodgkin's lymphoma (per 100 000 person-years, age-adjusted, 1970 U.S. population), 1970-1989, by state economic area. OBS = observed.

from the highest to the lowest decile to reveal geographic patterns. Among white men, the rates ranged from under 1.9 (per 100 000 person-years) in the lowest decile to greater than 3.5 in the highest for melanoma of the skin, from under 0.7 to greater than 1.7 for non-melanoma skin cancer, and from under 5.3 to greater than 7.4 for NHL.

Among white men (Fig. 1, A) and white women (Fig. 1, B), the updated maps for melanoma of the skin and non-melanoma skin cancer each continued to display a marked gradient with latitude;

the highest rates were in the South. NHL mortality showed no consistent latitude gradient, although some high-rate areas appeared in the North. In particular, rates in men and women were elevated in the Midwest, in the Plains, and in parts of New York State and northern New England. In addition, high rates appeared in scattered coastal areas (northern California, Washington State, southern Louisiana, the Mid-Atlantic, and New England). NHL mortality rates showed generally similar patterns in white men and white women, with a more

pronounced concentration in the Midwest and the Plains evident among women.

Some areas (e.g., San Francisco) with high NHL mortality among white men during the most recent decade reflect the early presence of HIV infection (13). Nevertheless, the geographic patterns of the 1980s were generally similar to those of the decades before the emergence of HIV-related NHL (12).

UV radiation levels depend on meteorological conditions as well as on latitude. Adjusting for latitude, altitude, and cloud cover, we estimated annual ambient levels of solar UVB radiation, measured in Robertson-Berger (RB) units. The measurements were taken from RB meters, which measure radiation in the UVB range according to the action spectrum for skin erythema, averaged from 1974 to 1987 (14).

In Fig. 2, we compared the estimated average UVB level in each state with the average white male mortality rate for each cancer during approximately the same period (1978-1988). We fitted regression models with the estimated state-specific UVB as the independent variable and state mortality rates (on a logarithmic scale) for melanoma of the skin, nonmelanoma skin cancer, and NHL as the dependent variables. On average, the higher the estimated level of UVB was in a state, the higher the mortality rates were for both melanoma and nonmelanoma skin cancers. In particular, each additional RB unit corresponded to a 0.24% higher rate of mortality from melanoma of the skin and a 0.39% higher rate of mortality from nonmelanoma skin cancer. By contrast, each additional RB unit corresponded to a 0.16% lower rate of mortality from NHL. All three coefficients were statistically significant ($P < .0001$), and the coefficients of variation were 0.287, 0.293, and 0.339, respectively.

The relationships between average UVB level and average mortality rates were similar among white women (data not shown). Each additional RB unit corresponded to a 0.16% higher rate of mortality from melanoma of the skin, a 0.14% higher rate of mortality from nonmelanoma skin cancer, and a 0.17% lower rate of mortality from NHL. The coefficients of variation were 0.136,

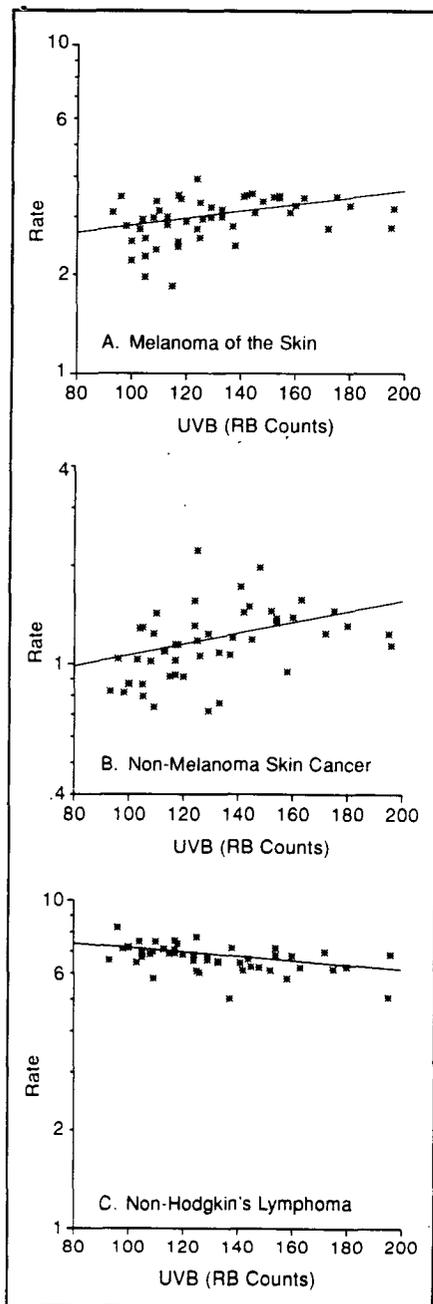


Fig. 2. White men. Mortality rates for melanoma of the skin (A), nonmelanoma skin cancer (B), and non-Hodgkin's lymphoma (C) (per 100 000 person-years, age-adjusted, 1970 U.S. population), 1978-1988, by state, according to estimated ultraviolet-B (UVB) radiation level, adjusted for cloud cover, altitude, and latitude. RB = Robertson-Berger units.

0.061, and 0.444 for melanoma of the skin, nonmelanoma skin cancer, and NHL, respectively.

We lacked data on long-term trends in UVB levels, but we compared average UVB levels with long-term trends in mortality from melanoma of the skin, nonmelanoma skin cancer, and NHL in white men and white women (data not shown). We fitted the annual percent change in the state mortality rate from 1950 to 1989 (on a logarithmic scale) to the average state UVB level. Melanoma of the skin and nonmelanoma skin cancer mortality rates rose faster in states with lower UVB levels, but the rates of increase in NHL mortality did not vary with UVB levels.

These data suggest that the overall geographic variation in mortality rates for NHL in the United States does not reflect higher levels of UV radiation. Our survey could not exclude a subtle association between NHL and sunlight, for instance, if UV radiation acted as a cofactor, if only particular cell types of NHL were affected, or if intermittent rather than cumulative UV radiation exposure altered risk. Nonetheless, the survey shows that sunlight does not bear the same clear relationship to NHL evident in the geographic variation of melanoma of the skin and nonmelanoma skin cancers. The continuing pattern of high mortality rates for NHL in the Plains, the Midwest, and certain coastal areas warrants further exploration.

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Notes

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