

## Cancer Surveillance Series: Changing Patterns of Cutaneous Malignant Melanoma Mortality Rates Among Whites in the United States

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**Background:** Mortality from melanoma among whites is still increasing in the United States. In this study, we describe the changing patterns of melanoma mortality rates among whites by demographic factors and geography and further assess the relationship between the geographic patterns and the UV radiation (UV-B) level. **Methods:** Age-adjusted incidence and mortality rates were computed by use of the 1970 U.S. population standard. Annual percent changes of mortality were estimated by fitting regression lines to the logarithm of rates. The relationships between melanoma mortality rates and UV-B level over time were assessed by weighted regressions. All statistical tests were two-sided. **Results:** From 1950–1954 through 1990–1994, melanoma mortality rates increased by 191% and 84% among males and females, respectively. Mortality rates peaked in the 1930 through 1950 birth cohorts for females and in the 1935 through 1950 birth cohorts for males. In the 1950 through 1969 study period, melanoma mortality rates showed a strong North–South gradient, but the gradient weakened in recent periods. The absolute change in mortality for a 10% increase in UV-B among females decreased from 0.08 additional deaths per 100 000 person-years in 1950–1959 to 0.01 additional

deaths in 1990–1995. In contrast, the absolute change in mortality among males showed little change over time; additional deaths increased from 0.11 to 0.12 per 100 000 person-years. **Conclusions:** Melanoma mortality in the United States reflects the complex interplay of UV radiation levels in each geographic region, the sun-protection behaviors of each generation of males and females in childhood and adulthood, the geographic mobility of the population, and the risk awareness and early detection. [J Natl Cancer Inst 2000;92: 811–8]

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Melanoma accounts for about 44 000 new cases and 7000 deaths yearly in the United States (1). Risk is associated with sun exposure, in particular, an intermittent pattern of exposure and a history of sunburn (2,3). The major host factor, fair complex-

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ion, is reflected in the international and ethnic patterns of melanoma rates (4-7). The major environmental factor, UV radiation (UV-B), is reflected in latitudinal gradients in risks in the United States (8,9) and Australia (10). Furthermore, incidence and mortality rates have risen steadily since at least in the middle of the 20th century (11,12), although the rise may have abated more recently, possibly as a result of early detection, changes in recreational behavior, and increased protection from sun exposure.

Despite these well-established features of melanoma epidemiology, it is not clear when the melanoma epidemic will peak, how the geographic patterns will be different than in the past, and whether changes will be the same in men and in women. To discern clues to the course and impact of the melanoma epidemic, we examined the most recent data on melanoma incidence and mortality among whites by sex and age. We estimated the patterns of mortality according to year of birth and sex to detect possible peak years of risk. We also tracked the geographic patterns over time and compared them with UV-B levels.

## MATERIALS AND METHODS

National mortality data from 1950 through 1994 for whites were acquired from the National Center for Health Statistics, Hyattsville, MD. Long-term incidence data were available for four geographic areas (Atlanta, GA; Connecticut, Detroit, MI; and San Francisco-Oakland, CA). These areas were surveyed for cancer incidence in the late 1940s and around 1970 (13) and are now participants of the ongoing Surveillance, Epidemiology, and End Results (SEER)<sup>1</sup> Program of the National Cancer Institute (Bethesda, MD), a population-based cancer registry program established in 1973. The distribution of melanoma incidence by stage for the 1973-1977 and 1992-1996 periods were analyzed in two groups of SEER registries classified according to their annual UV-B levels. The low UV-B areas included Connecticut, Detroit, Iowa, Seattle (WA), and Utah registries. The high UV-B areas included Atlanta, Hawaii, New Mexico, and San Francisco-Oakland registries. Person-years at risk were derived from population estimates provided by the Bureau of the Census (Suitland, MD). Age-adjusted rates were computed by use of the 1970 U.S. population as the standard.

Temporal changes in sex-specific incidence and mortality were presented by plotting the log-transformed age-adjusted rates. Estimated annual percent changes (EAPCs) of mortality rates from 1950-1954 through 1990-1994 for age groups (<25, 25-44, 45-64, 65-84, and ≥85 years) were obtained by fitting regression lines to the natural logarithm of age-adjusted rates for the nine 5-year time periods, weighted by the inverse of the estimated variance of the logarithm of age-adjusted rates, by use of calendar years (midpoint of periods) as the predictor variable (14); i.e.,  $Y = bx + c$ , where  $Y = \ln(\text{rate})$  and  $x = \text{calendar year}$ , and  $\text{EAPC} = 100 \cdot (e^b - 1)$ . Coefficients were tested across age groups for homogeneity. Birth cohort effects were described by plotting age-specific mortality rates from the period 1950-1954 through 1990-1994 for each 5-year age group according to birth year. Year of birth was obtained by subtracting the age at death from the year of death.

Geographic variations in the trends of melanoma mortality rates in the nine census divisions were evaluated by use of the same method as above. Geographic variations in mortality were further characterized by mapping rates at the state level, including the District of Columbia, for three time periods: 1950-1969, 1970-1984, and 1985-1994. Rates were categorized into eight groups, ranging from fewer than one to greater than or equal to four per 100 000 person-years, with an increment of 0.5. Maps were prepared by use of a red gradient, with intensity reflecting group level.

To evaluate the effect of UV-B levels on melanoma mortality rates over time, state-specific age-standardized mortality rates for the 48 contiguous states were computed for five time periods: 1950-1959, 1960-1969, 1970-1979, 1980-1989, and 1990-1995. The actual and log-transformed state-specific rates then were regressed each on state log-transformed UV-B level, weighted by the inverse of the estimated variance of the age-adjusted and the logarithm of age-adjusted rates, respectively. On the basis of these coefficients, the absolute and relative changes in mortality for a 10% increase in UV-B from a baseline UV-B exposure were estimated. The coefficients were tested for homogeneity across time periods. Annual UV-B, measured in Robertson-Berger (R-B) units, reaching a particular state was estimated by use of latitude, altitude, and cloud cover (15).

## RESULTS

From 1947-1950 through 1990-1994, melanoma incidence in the four geographic areas (Atlanta, Connecticut, Detroit, and San Francisco-Oakland) rose 543% from 2.80 to 17.99 per 100 000 person-years among white males and 317% from 2.80 to 11.68 among white females (Fig. 1). From 1950-1954 through 1990-1994, mortality from melanoma in the United States increased 191% from 1.20 to 3.49 per 100 000 person-years among males and 84% from 0.92 to 1.69 among females. The incidence rates rose more rapidly than the mortality rates, especially during the 1970s, and rose more rapidly in males than in females. In fact, the mortality rates among females seemed to have stabilized in recent years. The mortality trends for the four geographic areas followed closely the national mortality trends (data not shown), suggesting that the incidence trends in the four areas may fairly represent the national incidence trends.

From 1973-1977 through 1992-1996, the incidence of localized and regional plus distant-stage tumors among males increased by 208% (4.52-13.90 per 100 000 person-years) and 77% (1.30-2.30) in the low UV-B areas compared with 130% (6.94-15.98) and 45% (1.96-2.84) in the high UV-B areas. In females, the incidence of localized and regional plus distant-stage tumors rose by 140% (4.35-10.43 per 100 000 person-years) and 54% (0.81-1.25) in the low UV-B areas; in contrast, in the high UV-B areas, the incidence of localized tumor increased by only 63% (6.79-11.04), and the incidence of regional plus distant tumor decreased by 10% (1.1-0.99).

Table 1 shows the national melanoma mortality rates by sex and age group. Rates increased among both men and women in all age groups except in the youngest age group (age <25 years), in which it decreased. The rates of increase rose nonhomogeneously with age and were more pronounced among males than among females. Fig. 2, A and B, present the age-specific trends in melanoma mortality rates from 1950-1954 through 1990-1994, lagged according to cohort year of birth. The points vertically above each cohort year portray the cohort's age-specific mortality experience. Age-specific mortality rates among both females and males increased in each successive birth cohort born

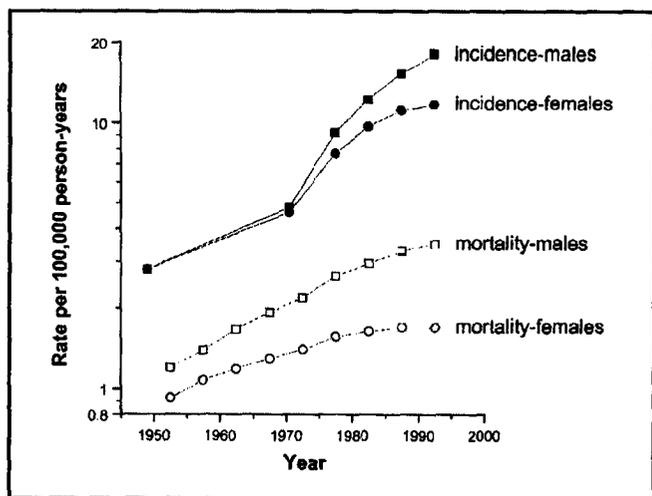


Fig. 1. Trends in age-adjusted (1970 U.S. population standard) skin melanoma incidence rates in four geographic areas (Atlanta, Connecticut, Detroit, and San Francisco-Oakland) combined and mortality rates among white males and females in the United States.

**Table 1. Patterns of skin melanoma mortality rates among whites by age group**

Age, y	Rates*		Change	
	1950 through 1954	1990 through 1994	Absolute	Annual %†
<b>Females</b>				
<25	0.10	0.05	-0.05	-1.3‡
25-44	0.90	1.15	0.25	0.4
45-64	1.68	3.31	1.63	1.7‡
65-84	3.03	6.83	3.80	1.9‡
≥85	5.67	12.71	7.04	2.2‡
<b>Males</b>				
<25	0.10	0.07	-0.03	-1.2
25-44	1.11	1.80	0.69	1.1‡
45-64	2.23	6.80	4.57	2.8‡
65-84	4.16	15.72	11.56	3.4‡
≥85	6.48	27.48	21.00	3.5‡

\*Per 100 000 person-years, age-adjusted within each age group by use of the 1970 U.S. standard population.

†Estimated by fitting regression lines to the natural logarithm age-adjusted rates.

‡Statistically significant ( $P < .05$ ) by use of two-sided Student's *t* test.

between 1860 and 1920, with the slopes steeper among males than among females. Rates peaked in the 1930 through 1950 birth cohorts for females and in the 1935 through 1950 birth cohorts for males and have declined among those born more recently.

Table 2 shows the mortality patterns among whites by census division (see Appendix Table 1), ranked in descending order according to their annual percent change. In all census divisions except one, mortality rates for females were lower than those for males in both the 1950-1954 and 1990-1994 periods, particularly

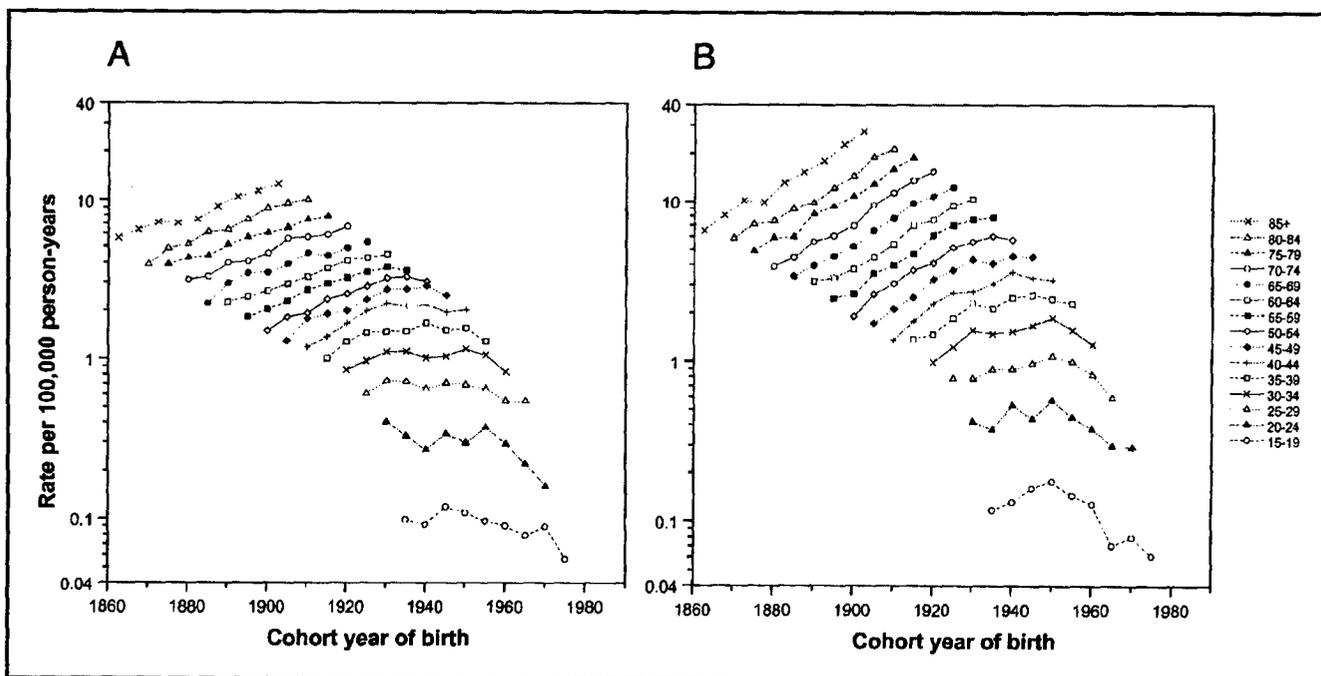
**Table 2. Patterns of skin melanoma mortality rates among whites by census division**

Census division	Rates*		Change	
	1950 through 1954	1990 through 1994	Absolute	Annual %†
<b>Females</b>				
New England	0.76	1.87	1.11	2.12‡
Middle Atlantic	0.78	1.67	0.89	1.81‡
East North Central	0.78	1.50	0.72	1.65‡
Mountain	1.07	1.79	0.72	1.63‡
Pacific	1.05	1.85	0.80	1.46‡
West North Central	0.90	1.61	0.71	1.35‡
South Atlantic	1.03	1.71	0.68	1.11‡
East South Central	1.23	1.74	0.51	0.60‡
West South Central	1.26	1.68	0.42	0.41
<b>Males</b>				
New England	1.07	3.54	2.47	2.98‡
Mountain	1.07	3.62	2.55	2.97‡
East North Central	0.92	3.02	2.10	2.93‡
Middle Atlantic	1.19	3.41	2.22	2.82‡
Pacific	1.38	3.80	2.42	2.66‡
West North Central	1.06	3.02	1.96	2.65‡
South Atlantic	1.35	3.93	2.58	2.56‡
East South Central	1.39	3.60	2.21	2.22‡
West South Central	1.70	3.46	1.76	1.60‡

\*Per 100 000 person-years, age-adjusted by use of the 1970 U.S. standard population.

†Estimated by fitting regression lines to the natural logarithm of age-adjusted rates. Census divisions are ranked in descending order according to their annual percent change.

‡Statistically significant ( $P < .05$ ) by use of two-sided Student's *t* test.



**Fig. 2. A)** Age-specific skin melanoma mortality trends among white U.S. women by cohort year of birth (from 1860 through 1980). **B)** Age-specific skin melanoma mortality trends among white U.S. men by cohort year of birth (from 1860 through 1980). Panels A and B show the age-specific melanoma mortality trends from 1950-1954 through 1990-1994, lagged according to year of birth. The points vertically above each cohort year portray the cohort's age-specific mortality experience.

in the recent period. In the earlier period in both males and females, rates were higher in the southern regions and lower in the northern regions. By comparison, rates were fairly similar among regions in the recent period. During the 45-year study period, melanoma mortality rates more than doubled in each of the regions for males and in only two of the regions for females. Nevertheless, ranking the census divisions by annual increase showed remarkable similarity for males and females. The largest increases occurred in the northern regions, and rates in the south-

ern regions rose less. In both males and females, the rates of increase among census divisions were nonhomogenous.

Fig. 3 shows estimated annual UV-B by state in Robertson-Berger (R-B) units (15). We analyzed data from 1974 through 1991 for a temporal change in UV-B gradient and found a nonsignificant decline. Fig. 4 shows sex- and state-specific melanoma mortality rates by period studied. State-specific melanoma mortality rates among females ranged from 0.69 to 1.75 per 100 000 person-years in 1950-1969 and from 1.35 to 2.58 in 1985-1994. All of the 50

Fig. 3. Estimated annual solar UV radiation in Robertson-Berger (R-B) units in the United States. Adapted from (15).

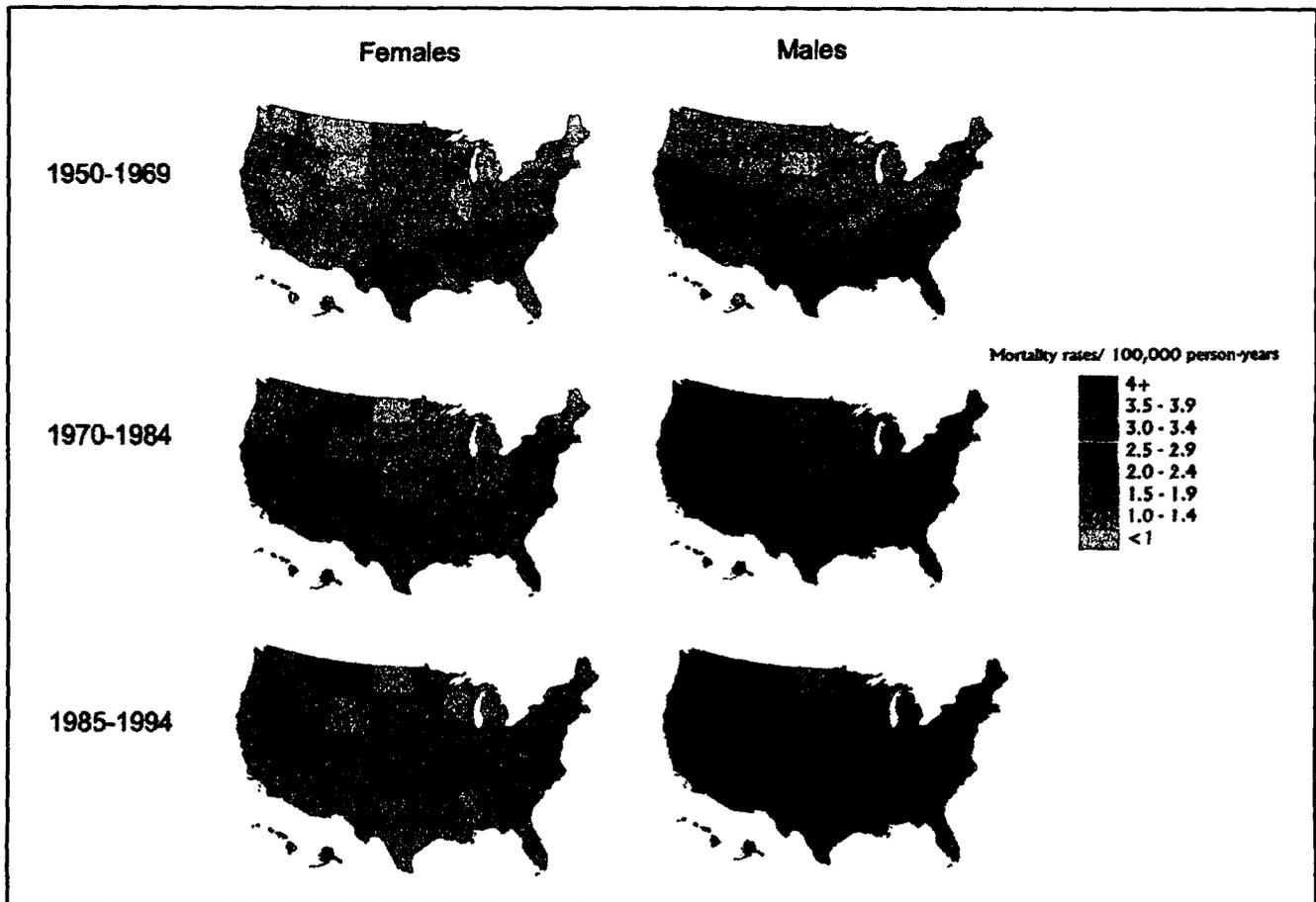
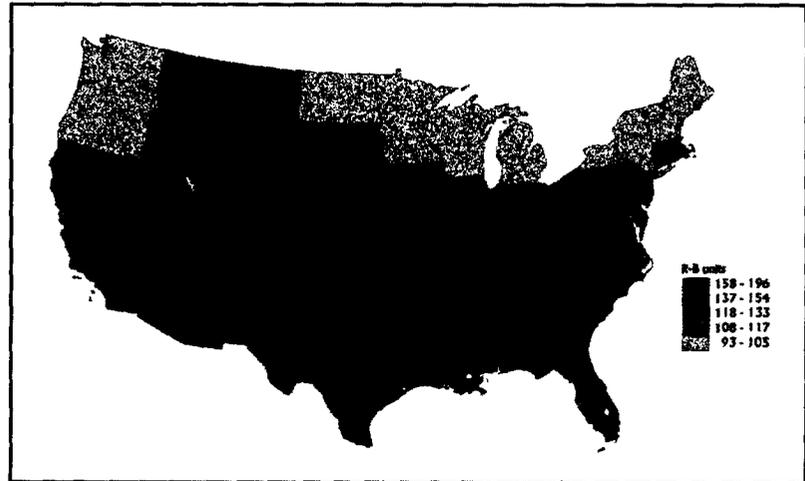


Fig. 4. Skin melanoma mortality rates among whites by state and period.

states and the District of Columbia (n = 51) in the earlier study period (1950-1959) and 86% (44 of 51 total areas) in the recent study period (1985-1994) fell in the lowest three color-coded categories with rates less than 1.9 per 100 000 person-years. All of the eight states that fell in the highest category in the earlier period were in the South, revealing a North-South gradient. In contrast, states with the highest rates in the recent period were not all from the South, suggesting less of a North-South gradient. Rates actually declined in Mississippi and in Texas, states with rates in the top 10% in the earlier period.

Among males, state-specific melanoma mortality rates ranged from 0.91 to 2.34 per 100 000 person-years and from 1.93 to 4.73 in 1950-1969 and 1985-1994, respectively (Fig. 4). In the 1950-1969 study period, the highest rates were in the southern states, while rates in the Mountain and North Central states were the lowest, indicating a strong North-South gradient. In the recent period, however, states as far north as Delaware had rates in the highest category, and states from the Southeast, West, Mountain, and North Central regions were in the second highest category, suggesting a weak North-South gradient, if any. During the study period, rates increased from 42% in Texas to 205% in South Dakota.

In Table 3, the UV gradient is measured on an absolute scale and on a relative scale in each of five time periods. Both models provided a comparable fit. The percent change or relative effect on skin melanoma mortality rates for a 10% increase in UV-B declined statistically significantly ( $P = .001$ ) from 9.1% in 1950-1959 to 0.6% in 1990-1995 among females and from 9.8% to 3.3% among males. The absolute change in mortality for a 10% increase in UV-B among females decreased significantly ( $P < .001$ ) from 0.08 additional deaths per 100 000 person-years in 1950-1959 to 0.01 additional deaths in 1990-1995. In contrast, the absolute change in mortality among males showed little

change over time; values ranged from 0.10 to 0.14 additional deaths per 100 000 person years.

## DISCUSSION

Our findings show that the geography of melanoma mortality has changed in the white population as the epidemic has eased its course. Rates now seen in the northern United States exceed those that were typical of the deep south in the 1950s. The geographic gradient persists, however, in an attenuated form. Our findings also suggest that mortality from melanoma peaked with the cohort of women born from 1930 through 1950 and for men born from 1935 through 1950. For the more recent period, mortality is stabilizing in women, whereas it is still rising slightly in men.

The incidence of melanoma is still rising among both men and women, but the patterns of incidence are complicated by changing surveillance and potential underreporting. Whether the rapid increase in incidence is real or a result of detection of indolent cases through increased surveillance has been a subject of many reports and reviews (16-19). For instance, the threefold increase in the incidence of cutaneous melanoma in the early 1980s in employees at the Lawrence Livermore National Laboratory (Livermore, CA) compared with that of the surrounding community was found to be because of intensive surveillance (16,17). In a more complete analysis of SEER incidence data from 1973 through 1994, Dennis (18) found some increase in the incidence of thick tumors and 2-year mortality in addition to a large increase in the incidence of thin tumors. She suggested that the rising melanoma rates in the United States are not entirely a result of greater early detection and diagnosis of clinically insignificant melanomas but may also represent true increases in risk. Similar suggestions, a real increase in incidence and increasing diagnosis of a pre-existing nonmetastasizing form of thin melanoma, were given for the rapid increase in incidence of melanoma in Australia (20,21).

Because of increasing diagnosis in nonhospital medical settings, potential underreporting of melanoma incidence because of missed cases in population-based registries has been well documented in the United States (22,23). In Massachusetts, the list of melanoma cases diagnosed from 1982 through 1986 in nonhospital dermatopathology laboratories was compared with the Massachusetts Cancer Registry records. It was found that 12% (364 of 3030) of the cases were unreported (22). In Iowa, based on a survey of dermatologists in 1995, from 10.4% to 17.1% cases of melanoma were not reported to the state's cancer registry (23). In Connecticut, underreporting of melanoma cases was suggested to be mainly because of diagnosis in out-of-state laboratories; however, it was also found that 14% (72 of 528) of the cases diagnosed in the state in 1988 were not reported to the state's tumor registry center by the end of 1990 (24).

The stabilizing mortality rates in females, consistent with previous reports (25,26), may be attributed, at least in part, to sex-specific differences in knowledge and awareness of skin melanoma and subsequent screening, sun-protection behaviors, and thickness and stage of melanoma at diagnosis. A survey of melanoma awareness and self-examination practices in the United States showed that the melanoma awareness percentage is significantly higher among females (39%) than among males (29%); that among white participants 25 years of age and older, 61% of women and 44% of men report skin self-examination; and that increased melanoma awareness and knowledge were

**Table 3.** Estimated absolute and relative changes in skin melanoma mortality rates among white males and females for a 10% increase in UV radiation (UV-B) level during the period from 1950 through 1995

	Absolute change in rate*			Relative change in rate		
	Coefficient	P	Change†	Coefficient	P	Change, %‡
<i>Females</i>						
1950-1959	0.887117	.0001	0.08§	0.913184	.0001	9.1§
1960-1969	0.845130	.0001	0.08§	0.709581	.0001	7.0§
1970-1979	0.707155	.0001	0.07§	0.473978	.0001	4.6§
1980-1989	0.343631	.0039	0.03§	0.197258	.0076	1.9§
1990-1995	0.117065	.4112	0.01	0.063362	.4739	0.6
<i>Males</i>						
1950-1959	1.200265	.0001	0.11§	0.983252	.0001	9.8§
1960-1969	1.421118	.0001	0.14§	0.764574	.0001	7.6§
1970-1979	1.390753	.0001	0.13§	0.539784	.0001	5.3§
1980-1989	1.049392	.0001	0.10§	0.310931	.0001	3.0§
1990-1995	1.252173	.0001	0.12§	0.339326	.0001	3.3§

\*Per 100 000 person-years, age-adjusted by use of the 1970 U.S. standard population.

†Change per 100 000 person-years. For example, for females, the estimated absolute change in mortality rate associated with a 10% increase in UV-B decreased from 0.08 additional deaths per 100 000 person-years in 1950-1959 to 0.03 additional deaths in 1980-1989.

‡Percent change in mortality. For example, in 1980-1989, the melanoma mortality rate among females increased by an estimated 1.9% for each 10% increase in UV-B.

§Statistically significant ( $P < .05$ ) by use of two-sided Student's *t* test.

associated with skin self-examination practice (27). In a study designed to characterize persons voluntarily screened for skin melanoma in Massachusetts, Koh et al. (28) found that 66% were female and 34% were male. Under the assumption that early detection and treatment reduce mortality from melanoma, the stabilizing mortality rates seen for females in the more recent period could be attributed partly to better awareness of and knowledge about melanoma.

Sunscreen use is recommended as a primary prevention method against melanoma in addition to wearing protective clothing and staying in the shade during intense sun exposure (29,30). In a telephone survey of 3042 households, Koh et al. (31) studied the sunbathing habit and prevalence of sunscreen use among white adults in the United States. Of those individuals who reported sunbathing, 53% of the women used sunscreen routinely compared with only 36% of the men (odds ratio [OR] = 2.1; 95% confidence interval [CI] = 1.5–3.1). This high rate of routine sunscreen use by females may have contributed to the recent stabilizing mortality rates among females.

Hall et al. (26) analyzed the distribution of skin melanoma cases diagnosed in the SEER areas by tumor thickness and stage. The majority of the tumors diagnosed from 1988 through 1994 in both males and females were thin (<0.75 mm thick), and the incidence for the more recent period (from 1990 through 1994) increased for all thickness categories among males but only for thin tumors among females. They (26) reported that the incidence of local-stage melanomas rose by 233.8% among males and by 133.7% among females. In contrast, the incidence of regional and distant-stage melanoma increased by 75% among males and by only 23.5% among females. Also, our analysis of the distribution of melanoma incidence by stage and region showed that the incidence of regional and distant-stage tumor rose more in males than in females. These findings are important because thick and distant-stage tumors are more lethal than thin and local-stage tumors. For example, the 2-year and 5-year survival rates (18) are lower for patients with thick tumors (73% and 48%, respectively) than those for patients with all tumors (88% and 75%, respectively). Hence, the slower rise in thick and distant-stage tumors in females compared with males may have contributed to the stabilizing mortality rate from melanoma among females and continuing increases in rates among males.

Examination of the mortality trends by age group and birth cohort revealed that the recent less rapidly rising or stabilizing age-adjusted mortality rates were a result of declining mortality in the younger age groups and more recent birth cohorts. The lifetime risk of melanoma mortality may have peaked for females born during the period from 1930 through 1950 and for males born during the period from 1935 through 1950. This is consistent with previously published reports (32–34), but the cohort effect in men is more discernible graphically in the present analysis because of the availability of more recent data points per cohort. The present analysis also revealed a downturn of mortality in age groups as old as 55–59 years. Closely similar birth cohort mortality patterns were also reported in different parts of the world. For instance, in Australia, the rates peaked around the 1925 birth cohort in women and around the 1935 birth cohort in men (10); in Sweden, the rates increased up to the 1947 birth cohorts in women and the 1932 birth cohorts in men (35). The increases in mortality among the older age groups for each subsequent birth cohort indicate an increase in risk from one generation to the next, perhaps as a result of lifestyle change

such as recreation practices. In contrast, the use of sun-protection methods and early-stage diagnosis could be the most likely reasons for the downturn of mortality rates for cohorts born after 1950. Analogous age-specific mortality trends, a downturn in the younger age groups and an upward trend in the older age groups, were reported in New Zealand (12).

Our analysis of geographic variation in mortality rates by census division demonstrated that mortality rates increased more rapidly in both males and females in the northern regions of the United States. This was a combined effect of high rates in the census divisions in the South during the earlier study period and relatively homogeneous rates among North and South census divisions in the more recent period. Also, mapping of rates by state showed a North–South gradient for the 1950–1969 period, more marked for males than for females. But the gradient was not as clear in the more recent period, with rates tending to be uniform across the United States. The changes in mortality patterns over time were not explained by sex-specific birth cohort differences between the North and the South (data not shown). Nevertheless, it is noteworthy that sun exposure may be becoming more homogeneous in the United States as northerners take vacations in the South. Sun-seeking holidays have been shown to measurably increase risk of melanoma among Canadians in Canada (36).

Lee (37) estimated the gradient of skin melanoma mortality with latitude among U.S. whites by fitting state-specific melanoma mortality rates with latitudes of the state's capital. He found that the North–South gradient of melanoma mortality has been decreasing since 1950–1959. Our results on the relationship of UV-B and melanoma mortality rates over time show that the UV radiation gradient persists but appears to be less striking than in the past, in agreement with Lee's findings. While the relative change in mortality for a unit increase in UV-B has declined over time in both sexes, the absolute change in mortality rates for a unit increase in UV-B has declined only in females and remained constant in males. This suggests that the impact of UV-B radiation on melanoma mortality rates is still important among males but may have diminished among females. The preceding statement could be supported by results from our analysis of the distribution of melanoma incidence by stage and region. Over the approximate 20-year period, the incidence of regional plus distant-stage tumor rose more in the low UV-B areas than in the high UV-B areas and more in males than in females. Especially in females, the incidence decreased in the high UV-B areas. These patterns may provide clues as to why mortality rates rose more in the North (low UV-B areas) than in the South (high UV-B areas) and why the rate among females is stabilizing. Possible reasons for the regional and sex differences in mortality and incidence patterns include differences in sun-protection behaviors and response to campaigns for early detection.

Since exposure in childhood (38) or intense intermittent exposure (2,3,39) may be risk factors for development of cutaneous melanoma, migration and differences in sun-protection behaviors among or between sun-sensitive and sun-insensitive people may have contributed to the recent geographically homogeneity of melanoma mortality rates. It is suggested that migration between geographic areas greatly reduces the sensitivity of methods for assessing cancer risk from environmental exposure, especially when the disease in question has a long latency period (40).

On the basis of the 1992 National Health Interview Survey Cancer Control Supplement, 53% of the respondents reported that they were very likely to use sun protection if they were outside on a sunny day for more than 1 hour and that the odds of practicing sun-protection behavior increased with increasing sun sensitivity (41). Compared with people who do not sunburn, those reporting severe sunburn after 1 hour of sun exposure reported more use of sunscreen (OR = 2.4; 95% CI = 2.0–2.9), protective clothing (OR = 2.2; 95% CI = 1.9–2.7), and shade (OR = 1.8; 95% CI = 1.5–2.1).

Melanoma mortality in the United States reflects the complex interplay of UV radiation levels in each geographic region, the sun-protection behaviors of each generation of males and females in childhood and adulthood, the geographic mobility of the population, and the risk awareness and early detection. These data show the value of continuing surveillance of mortality and incidence of this serious form of skin cancer.

**Appendix Table 1.** Definitions of census divisions according to the Bureau of the Census (Suitland, MD)

Division	States
New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
Middle Atlantic	New Jersey, New York, and Pennsylvania
East North Central	Illinois, Indiana, Michigan, Ohio, and Wisconsin
West North Central	Iowa, Kansas, Missouri, Minnesota, Nebraska, North Dakota, and South Dakota
Mountain	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming
Pacific	Alaska, California, Hawaii, Oregon, and Washington
South Atlantic	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
East South Central	Alabama, Kentucky, Mississippi, and Tennessee
West South Central	Arkansas, Louisiana, Oklahoma, and Texas

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## NOTES

*Editor's note:* SEER is a set of geographically defined, population-based, central cancer registries in the United States, operated by local nonprofit organizations under contract to the National Cancer Institute (NCI). Registry data are submitted electronically without personal identifiers to the NCI on a biannual basis, and the NCI makes the data available to the public for scientific research.

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