

Trends in Nonmelanoma Skin Cancer Mortality Rates in the United States, 1969 through 2000

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The purpose of this population-based study was to assess trends in mortality rates for nonmelanoma skin cancer (NMSC) in the United States. Particular emphasis was placed on the subgroup of malignancies arising on genital skin. Nearly 75,000 deaths in the United States were attributed to NMSC from 1969 to 2000. The age-adjusted US mortality rate for NMSC arising on nongenital skin from 1969 to 2000 was 0.69/10⁵/year; the rate among men was twice that among women. Mortality rates among white men exceeded that of black men by a factor of two; the same was observed among women, but by a smaller multiple. Corresponding mortality rates for malignancies arising from genital skin (penis, scrotum, vulva) were higher in women (0.54) than in men (0.30). In contrast to nongenital NMSC, mortality rates among black men were twice that of white men; however, rates for white and black women were similar. These results suggest that greater emphasis could be placed on reducing mortality from genital NMSC while continuing to stress reduction of excess sun exposure.

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INTRODUCTION

Nonmelanoma skin cancer (NMSC) is the most common malignancy in the United States and its incidence is rapidly increasing (Boring *et al.* 1991; Karagas *et al.* 1999). Despite the magnitude of the public health burden, investigation of mortality from NMSC has been limited. Previous studies suggest that NMSC mortality rates in Germany (Stang and Jockel, 2004) and the United States declined through the latter part of the twentieth century (Weinstock *et al.* 1991; Weinstock 1993). However, the precision of these data can be questioned.

Accuracy with respect to cause of death certification has been examined in Rhode Island from 1979 through 2000. Results of these studies revealed that a significant proportion of deaths attributed to NMSC under International Classification of Disease (ICD) coding rubrics were misclassified and not due to NMSC (Weinstock *et al.* 1991; Lewis and Weinstock, 2004). Further investigation of this issue suggested that the problem of misclassification was not uncommon among public health departments across the United States (Weinstock *et al.* 1992). Correction for probable sources of misclassification is believed to proffer a more accurate estimate of trends in NMSC mortality rates in the United States.

The purpose of this study was to investigate trends in NMSC mortality rates in the United States from 1969 to 2000. Special emphasis was placed on mortality from genital skin cancers. To our knowledge, a population-based estimate of mortality rates for this subgroup of NMSC has not been reported previously.

RESULTS

There were 73,572 deaths attributed to NMSC in the United States from 1969 to 2000. Of these, 44,630 deaths resulted from primary tumors arising on nongenital skin (26,759 in men and 17,871 in women). An additional, 28,942 deaths were attributed to NMSC on genital skin (7,791 in men and 21,115 in women). Thus, the number of deaths attributed to vulvar skin cancer exceeded that of penile-scrotal skin cancer by nearly a factor of three. The age-adjusted US mortality rate from 1969 to 2000 was 0.69 (/10⁵/year) for nongenital NMSC, 0.30 for genital NMSC in men, and 0.54 for genital NMSC in women. In 1999 and 2000 in the United States, an average of 865 men and 571 women died per year of nongenital NMSC, another 220 men and 757 women died of genital NMSC.

Nongenital NMSC

Of the 44,630 deaths attributed to nongenital NMSC, 41,585 (93%) occurred in whites and 2,752 (6%) occurred in blacks. Mortality rates for nongenital NMSC were strongly age-related with the highest crude rate occurring in the oldest age group (Table 1). Exclusive of NMSC arising on genital skin, the age-adjusted mortality rate for nongenital NMSC was 0.69 (1.02 in men and 0.46 in women). The rate among white men (1.09) was higher than that among black men (0.54) by a factor of two, whereas rates for white women (0.48) here were modestly higher than that of black women (0.38).

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Abbreviations: NMSC, nonmelanoma skin cancer

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Table 1. Age-specific NMSC mortality rates in the United States, 1969–2000

Age group	Nongenital rate (no.)	Genital	
		Men	Women
00–54 years	0.75 (6,922)	0.04 (1,174)	0.06 (1,725)
55–64 years	0.89 (6,047)	0.50 (1,575)	0.65 (2,320)
65–74 years	1.90 (9,766)	0.97 (2,150)	1.73 (5,006)
75–84 years	4.35 (12,069)	1.89 (1,961)	3.99 (6,919)
85+ years	11.91 (9,826)	4.09 (965)	8.73 (5,181)

NMSC, nonmelanoma skin cancer.

Rates are expressed as the number of deaths per 10⁵ at-risk individuals per year.

Table 2. Age-adjusted NMSC mortality rates in the United States, 1969–2000

	1969–1974	1975–1984	1985–1994	1995–2000
<i>Genital</i>				
Men	0.42 (n=1,688)	0.32 (2,463)	0.25 (2,238)	0.22 (1,402)
Whites	0.37 (1,306)	0.29 (1,982)	0.23 (1,877)	0.21 (1,213)
Blacks	1.0 (369)	0.67 (455)	0.44 (328)	0.31 (164)
Women	0.67 (3,558)	0.54 (6,021)	0.50 (6,907)	0.48 (4,665)
Whites	0.65 (3,175)	0.54 (5,479)	0.50 (6,230)	0.50 (4,305)
Blacks	0.76 (363)	0.52 (515)	0.53 (625)	0.37 (316)
<i>Nongenital</i>				
Men	1.14 (4,154)	1.08 (7,962)	1.02 (9,360)	0.79 (5,128)
Whites	1.20 (3,923)	1.14 (7,535)	1.10 (8,793)	0.87 (4,880)
Blacks	0.63 (231)	0.55 (427)	0.59 (567)	0.36 (248)
Women	0.58 (2,873)	0.49 (5,486)	0.42 (5,743)	0.37 (3,631)
Whites	0.58 (2,648)	0.50 (5,073)	0.44 (5,319)	0.40 (3,414)
Blacks	0.51 (225)	0.42 (413)	0.35 (424)	0.25 (217)

NMSC, nonmelanoma skin cancer.

Rates are age-adjusted to the 2000 US standard population and are expressed as the number of deaths per 10⁵ at-risk individuals per year.

Mortality rates generally declined over time, although the proportional decline among blacks (43% in men and 51% in women) was greater than that among whites (27% in men and 30% in women) (Table 2).

Mortality rates in white men declined consistently from 1969 to 2000 with the notable exception of the interval from 1981 to 1988 during which a sharp increase in mortality rates was observed (Figure 1). A similar rise in the mortality rates for black men was also seen during the same time interval. During these years the proportion of deaths occurring in males under 60 years of age increased more than twofold to nearly 50% of all deaths attributed to nongenital NMSC. There was no significant change in the number of deaths occurring in men over 60 years. The number of deaths and the mortality rate returned quickly to the pre-1980 trend-line

following this time period. The aberrancy was limited to nongenital skin cancers; mortality rates for NMSC on genital skin did not fluctuate during this period. This period corresponds to the years in which deaths due to AIDS-related Kaposi’s sarcoma were coded under NMSC rubrics. Subsequent revisions in the ICD reassigned these causes of deaths to alternate rubrics. By contrast, nongenital NMSC mortality rates for white and black women declined steadily over time.

Although uncorrected NMSC mortality rate calculations (i.e., based on records coded under the 173.0–173.9 rubrics) are thought to be less accurate because of misclassification of the underlying cause-of-death, uncorrected age-adjusted US NMSC mortality rates are presented to facilitate comparison with results of international studies of NMSC mortality (Table 3).

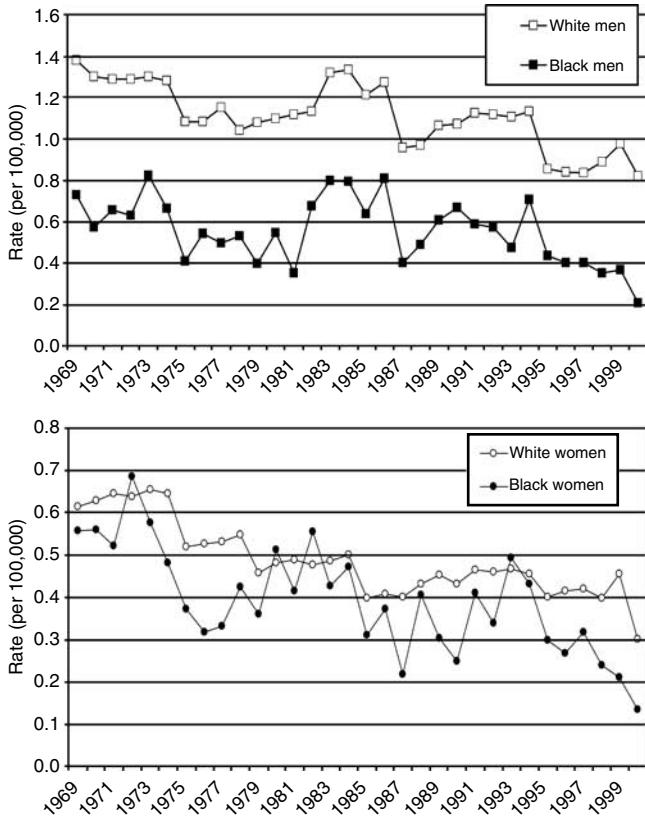


Figure 1. Nongenital NMSC mortality rates in the United States, 1969-2000.

Genital NMSC

Of the 7,791 deaths attributed to genital NMSC in men, 6,378 (82%) occurred in white men and 1,316 (17%) occurred in black men. Of the 21,156 deaths attributed to genital NMSC in women, 19,189 (91%) occurred in white women and 1,819 (9%) occurred in black women. Mortality rates for genital NMSC were strongly age-related with the highest crude rate occurring in the oldest age group for both men and women (Table 1).

The age-adjusted mortality rate for primary tumors of genital skin was 0.30 in men and 0.54 in women (Figure 2). The rate among black men (0.59) was greater than that among white men (0.27), whereas rates for black and white women were the same (0.54). In recent years, the annual mortality rates among men have converged although rates among black men were notably higher during the 1970s and were nearly three times those of white men during this time. Mortality rates in both white and black women declined over time. During the last two decades, mortality rates in white women remained relatively steady, whereas rates in black women continued to decline. During the last 6 years of the study, mortality rates in white women exceeded that in black women (Figure 2).

DISCUSSION

The age-adjusted US mortality rate for nongenital NMSC was 0.69 from 1969 to 2000. Rates were strongly age-related and

Table 3. Uncorrected age-adjusted ICD-9 173.x mortality rates in the United States, 1969-2000

Year	Male	Female	Total
1969	1.5	0.7	1.0
1970	1.3	0.7	0.9
1971	1.4	0.6	0.9
1972	1.4	0.6	0.9
1973	1.3	0.6	0.9
1974	1.3	0.6	0.9
1975	1.3	0.6	0.9
1976	1.3	0.6	0.9
1977	1.4	0.6	0.9
1978	1.3	0.6	0.9
1979	1.2	0.5	0.8
1980	1.3	0.4	0.8
1981	1.3	0.4	0.8
1982	1.4	0.5	0.8
1983	1.6	0.5	0.9
1984	1.6	0.5	0.9
1985	1.7	0.4	1.0
1986	1.8	0.5	1.0
1987	1.6	0.5	0.9
1988	1.6	0.5	0.9
1989	1.7	0.5	1.0
1990	1.7	0.4	0.9
1991	1.6	0.5	0.9
1992	1.6	0.5	0.9
1993	1.5	0.4	0.9
1994	1.5	0.4	0.9
1995	1.4	0.4	0.8
1996	1.3	0.4	0.8
1997	1.3	0.4	0.8
1998	1.3	0.4	0.8
1999	1.5	0.4	0.9
2000	1.4	0.4	0.8

ICD, International Classification of Disease. Rates are age-adjusted to the US 2000 standard population and expressed as the number of deaths per 10⁵ at-risk individuals. Data are derived from the SEER cancer query resource <http://seer.cancer.gov/canques/mortality.html> (accessed 9 March, 2007).

generally declined over time. Although mortality rates among white men were notably higher than among black men, rates among white and black women were less disparate. The corresponding rates for genital NMSC were 0.30 in men and 0.54 in women. Rates were strongly age-related and generally declined over time. Mortality rates for genital NMSC among black men were substantially higher than

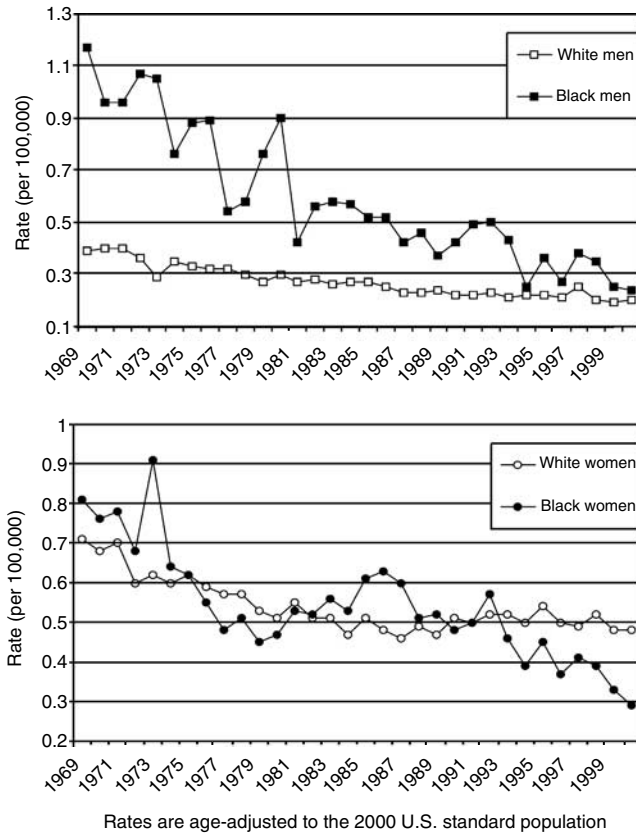


Figure 2. Genital NMSC mortality rates in the United States, 1969-2000.

among white through the 1970s although rates between these two groups appear to have converged in recent years. Rates among white and black women have been comparable over time; mortality rates among white women slightly exceeded that among black women during the 1990s.

The data presented herein are comprehensive and provide population-based estimates for NMSC in the United States. However, there are several limitations to this study that should be acknowledged. NMSC mortality data for the US population is pooled from individual state public health departments that in turn rely on cause of death certification for deaths among individuals who reside in their respective states. Death certificates were certified by licensed physicians who may or may not have cared for the deceased during the course of their diseases. Post-mortem examinations are performed rarely in the United States. Therefore, in cases of advanced local or metastatic NMSC, the histology of the primary tumor may not be evident. In particular, frank ulceration of the face from a squamous cell carcinoma that originated in the oral mucosal may appear clinically to have originated on the skin in the advanced stages of disease. Evidence for this potential source of error is available from a detailed review of medical records in Rhode Island in which many deaths attributed (on death certificates) to NMSC were actually misclassified (Lewis and Weinstock, 2004). The 173.4 rubric largely captured these misclassified cases, so deaths coded under this rubric were excluded from this study.

In addition, US mortality data do not include deaths due to NMSC that were incorrectly classified under a different cause of death. This source of misclassification would result in an underestimation of true mortality rates. Periodic revisions of the ICD may also introduce artifactual changes in mortality rates owing to the creation, deletion, inclusion, or exclusion of specific coding rubrics within general categories.

We are unaware of previous population-based estimates of mortality rates for genital skin cancer. The estimated US mortality rates for vulvar and penile skin cancer suggest that mortality due to genital NMSC represents about half of all deaths due to NMSC in this country. In addition, although men are three times as likely to die from nongenital NMSC as NMSC of the penis and scrotum, mortality rates among women are actually slightly higher for vulvar skin cancer than for nongenital NMSC. The magnitude of the public health burden is great; nevertheless, efforts on the part of the dermatology community to prevent human papilloma virus infection in the United States have been slight compared to similar effort to reduce excess exposure to UV light. These data suggest that greater emphasis could be placed on the risk of mortality from genital skin cancer, both in efforts with patients and with physicians in related specialties such as family medicine and obstetrics-gynecology.

MATERIALS AND METHODS

The data presented herein are derived from the records of the vital statistics of the US National Center for Health Statistics and include all reported deaths attributed to NMSC from 1969 to 2000. The ICD-9 coding rubrics 173 (NMSC), 184 (vulvar skin cancer, excluding 184.0), 187 (penile and scrotal skin cancer), 154.3 (perianal skin), 176.0 (non-AIDS-related Kaposi's sarcoma of the skin), and 140 (including 140.0, 140.1, and 140.9; NMSC of the lip) were included. Cutaneous lymphomas (ICD-9 202.1, 202.2 and ICD-10 C84.0, C84.1) were excluded. Subsequently, deaths coded under ICD-9 rubric 173.4 were excluded to correct for a probable source of misclassification. (Lewis and Weinstock, 2004) Unless otherwise specified, calculated mortality rates exclude rubric 173.4 and are age-adjusted to the US 2000 standard population. Rates are expressed as the number of deaths per 10⁵ at risk individuals per year. Denominators of calculated mortality rates are derived from point estimates of the US population obtained from the US Census Bureau. Definitions of race and gender are those used by the 2000 US census.

CONFLICT OF INTEREST

The authors state no conflict of interest.

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REFERENCES

Boring CC, Squires TS, Tong T (1991) Cancer statistics, 1991. *CA Cancer J Clin* 41:19-36

- Karagas MR, Greenberg ER, Spencer SK, Stukel TA, Mott LA (1999) Increase in incidence rates of basal cell and squamous cell skin cancer in New Hampshire, USA. New Hampshire Skin Cancer Study Group. *Int J Cancer* 81:555-9
- Lewis KG, Weinstock MA (2004) Nonmelanoma skin cancer mortality (1988-2000): the Rhode Island follow-back study. *Arch Dermatol* 140:837-42
- Stang A, Jockel KH (2004) Declining mortality rates for nonmelanoma skin cancers in West Germany, 1968-99. *Br J Dermatol* 150:517-22
- Weinstock MA (1993) Nonmelanoma skin cancer mortality in the United States, 1969 through 1988. *Arch Dermatol* 129:1286-90
- Weinstock MA, Bogaars HA, Ashley M, Litle V, Bilodeau E, Kimmel S (1991) Nonmelanoma skin cancer mortality. A population-based study. *Arch Dermatol* 127:1194-7
- Weinstock MA, Bogaars HA, Ashley M, Litle V, Bilodeau E, Kimmel S (1992) Inaccuracies in certification of nonmelanoma skin cancer deaths. *Am J Public Health* 82:278-81