Ethnic Differences Among Patients With Cutaneous Melanoma

Janice N. Cormier, MD, MPH; Yan Xing, MD; Meichun Ding, PhD; Jeffrey E. Lee, MD; Paul F. Mansfield, MD; Jeffrey E. Gershenwald, MD; Merrick I. Ross, MD; Xianglin L. Du, PhD

Background: Melanoma incidence continues to increase in whites, but little is known about melanoma in minority populations. Surveillance, Epidemiology, and End Results (SEER) data were used to examine the incidence, manifestations, and survival in patients with melanoma with respect to race/ethnicity.

Methods: A SEER search (1992-2002) for primary invasive cutaneous melanoma cases identified 48 143 whites, 932 Hispanics, 394 Asian/Pacific islanders, 251 African Americans, and 52 American Indians. Multivariate analyses were performed to evaluate the relationship between race/ethnicity and clinicopathologic factors; associations between race/ethnicity and survival were examined using the Cox proportional hazards model.

Results: Based on our cohort of patients, the average annual age-adjusted melanoma incidence per 100 000 persons was 18.4 for whites compared with 2.3, 0.8, 1.6, and 1.0 for Hispanics, African Americans, American Indians, and Asians, respectively. Lower extremity and acral lentiginous melanomas were more common among minorities. Overall 5-year survival was 72.2% to 81.1% for minorities compared with 89.6% for whites. A 1.96- to 3.01-fold greater risk of disease-specific mortality persisted in minorities compared with whites after adjusting for age, sex, and region. In addition, Hispanics (odds ratio [OR], 3.6), African Americans (OR, 4.2), American Indians (OR, 3.4), and Asians (OR, 2.4) were more likely to present with stage IV melanoma than were whites. African Americans had a 1.48-fold higher rate of risk-adjusted, stage-specific mortality compared with whites.

Conclusions: Melanoma is a public health concern for all ethnic populations. Differences in disease stage at presentation contributes to disparities in survival. Understanding melanoma in minority populations may lead to early detection and ultimately save lives.

Arch Intern Med. 2006;166:1907-1914

Author Affiliations: The University of Texas M. D. Anderson Cancer Center, Houston (Drs Cormier, Xing, Lee, Mansfield, Gershenwald, and Ross); Amgen Inc (Dr Ding), Houston; and The University of Texas School of Public Health, Houston (Dr Du).

INCIDENCE RATES FOR MELANOMA have been increasing rapidly for several decades in white populations.[1] A population-based study from the California Cancer Registry recently reported that rates of invasive melanoma have also increased markedly among Hispanics since 1988.[2] In general, there is a paucity of literature pertaining to the incidence of melanoma in minority populations.[3,4]

Primary melanoma occurs more commonly in unusual anatomic sites (eg, palms and soles) in minority populations than in whites.[5] Given the reported rarity of its occurrence and its unusual presentation, it is not surprising that the diagnosis of melanoma is often delayed in minority populations, resulting in more advanced stages of disease at presentation.[6] This delay in diagnosis is critical because early detection and treatment of thin melanomas results in better survival. Considering that the US Census Bureau has projected that the population of Hispanics and Asians in the United States will increase by 30% from 2000 to 2010 and that the overall incidence of melanoma continues to rise,[7] it is imperative that clinicians have an understanding of the manifestations and outcomes of melanoma in minority patients so that early detection and treatment is not overlooked in these populations. In this study, we examine contemporary data from Surveillance, Epidemiology, and End Results (SEER) tumor registries to examine disparities among various ethnic groups in the United States in terms of melanoma incidence, histologic subtype, disease stage at presentation, and disease-specific survival.

METHODS

DATA SOURCES

Data from the SEER program of the National Cancer Institute public use data set were extracted for population data and patients diagnosed as

having primary cutaneous invasive melanoma from 1992 through 2002. During this time, the SEER program supported population-based prospective tumor registries in the following 11 areas: the metropolitan areas of San Francisco/Oakland, Calif; Detroit, Mich; Atlanta, Ga; and Seattle, Wash; Los Angeles County, California; the San Jose/Monterey area, Calif; and the states of Connecticut, Iowa, New Mexico, Utah, and Hawaii. The SEER data include demographic characteristics such as age, sex, race/ethnicity, and marital status; primary tumor location; pathologic data, including histologic tumor type; Breslow thickness; presence or absence of primary tumor ulceration; lymph node metastasis and distant organ metastases; and treatment rendered in the first 4 months following diagnosis.

Marital status is categorized in SEER into 3 groups: married, unmarried (single, separated, divorced, or widowed), and unknown. For this analysis, race/ethnicity was categorized as white (non-Hispanic), Hispanic, African American, American Indian, or Asian/Pacific islander. The SEER registries were combined into 4 geographic regions: West (San Francisco, Hawaii, Seattle, San Jose/Monterey, Los Angeles, Utah, and New Mexico); Midwest (Iowa and Detroit); Northeast (Connecticut); and South (Atlanta). The objective of using regions instead of individual registries in SEER was to account for potential geographic variation while still including smaller registries with fewer minority patients in the multivariate analysis. The year 1992 was selected as the beginning of the study period because in that year 2 registries were added to the SEER program—those serving the urban areas surrounding Los Angeles and San Jose/Monterey, both of which contain racially and ethnically diverse populations.

STUDY COHORT

All patients with a diagnosis of primary cutaneous melanoma (identified by the SEER code 25010)[8] during the years 1992 through 2002 were potentially eligible for inclusion. Patients with melanoma in situ (corresponding to summary stage 1977 SEER code 0) were excluded, thus restricting the study cohort to patients with a histologic diagnosis of invasive melanoma (histologic type, *International Classification of Diseases for Oncology, Third Edition* [*ICD-O-3*], SEER codes 8720, 8721, 8723, 8730, 8741, 8743-8746, 8770-8772, and 8780). We further selected those patients with adequate pathologic information for classification according to the American Joint Committee on Cancer (AJCC) staging system.[9] Given these criteria, 53 159 patients with invasive melanoma were potentially eligible. Additional patients were excluded for the following reasons: cancer was diagnosed at autopsy or only on the death certificate (n=118), race/ethnicity was classified as "other" (n=69) or "unknown" (n=2360), and Hispanic ethnicity was classified as "Spanish surname only" or "unknown" (n=834). In addition, for the race/ethnicity categories to be mutually exclusive, 5 African Americans and 1 Asian/Pacific Islander were excluded because they were also categorized as being Hispanic.

The study cohort thus included 49 772 patients with primary invasive melanoma, including 48 143 whites (96.7%), 932 Hispanics (1.9%), 394 Asian/Pacific islanders (0.8%), 251 African Americans (0.5%), and 52 American Indians (0.1%).

STATISTICAL ANALYSES

The average age-adjusted melanoma incidence rates (per 100 000 persons) were calculated for each race/ethnicity group standardized by the US population in 2000. The estimated annual percentage change over 11 years (1992-2002) was calculated with 95% confidence intervals (CIs) to measure trends over time for each race/ethnicity.

Descriptive characteristics for each race/ethnicity group examined include the following: age at diagnosis, sex, marital status, SEER registry location, year of diagnosis, primary tumor location, histologic subtype, and AJCC tumor stage.[9] Unadjusted probabilities for disease-specific survival were estimated using the method of Kaplan and Meier,[10] and intergroup comparisons were made using the log-rank test.[11]

Associations between race/ethnicity and disease-specific survival were estimated using the Cox proportional hazards regression model.[12] Cox regression analysis was performed using SAS version 9.1 (SAS Institute, Cary, NC) for Windows to compute hazard ratios and 95% CIs and to evaluate the effects of confounding and modifying factors. We used 2 models to assess disease-specific survival: one that was adjusted for age, sex, and SEER region and a second, more complex model that accounted for other potential confounders including marital status, year of diagnosis, primary tumor site, histologic subtype, and AJCC stage. In all of the models, whites served as the reference group for race/ethnicity, and stage I was used as the reference category for AJCC stage.

Using statistical software (Stata/SE version 8 for Windows; StataCorp, College Station, Tex), multinomial logistic regression was performed to compute odds ratios (ORs) and 95% CIs[13] and to evaluate the effects of confounding and modifying factors on the association between race/ethnicity and AJCC melanoma stage. In this model, the reference category used was stage I. In addition to adjusting all analyses for age, sex, marital status, year of diagnosis, region, anatomic site, and histologic subtype, we examined AJCC stage at presentation using whites as the reference group. All *P* values were 2-sided and considered significant at the .05 level.

RESULTS

PATIENT CHARACTERISTICS

Based on the eligible cohort, the average annual age-adjusted melanoma incidence per 100 000 persons was 18.4 (95% CI, 18.3-18.6) for whites compared with 2.3 (95% CI, 2.2-2.5), 0.8 (95% CI, 0.7-0.9), 1.6 (95% CI, 1.2-2.1), and 1.0 (95% CI, 0.9-1.2) for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively. The estimated annual percentage change in melanoma incidence was 5.0% (95% CI, 4.1% to 5.9%) for whites compared with 1.0% (95% CI, –2.6% to 4.8%), 3.8% (95% CI, –3.4% to 11.6%), –0.6% (95% CI, –7.6% to 7.0%), and 6.1% (95% CI, 2.9% to 9.4%) for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively.

The clinical characteristics of the study cohort stratified according to race/ethnicity are presented in **Table 1**. The mean age at melanoma diagnosis was 57 years for whites, compared with 54 years for Hispanics, 59 years for African Americans, 52 years for American Indians, and 57 years for Asian/Pacific islanders ($P<.001$). Female sex represented a larger proportion of patients in minority populations than in the white population (50.6% to 54.5% vs 43.9%, respectively; $P<.001$). Compared with other ethnic populations, fewer African American patients (35.9%) were married. Overall, a majority of patients (62%) were from the West region. In particular, a large percentage of Hispanics (91.6%), American Indians (94.2%), and Asian/Pacific islanders (93.4%) were enrolled from the West.

Table 1. Comparison of Demographic Characteristics Among 49 772 Patients With Invasive Melanoma (1992-2002) According to Race/Ethnicity*

Characteristic	White (n = 48 143)	Hispanic (n = 932)	African American (n = 251)	American Indian (n = 52)	Asian/Pacific Islander (n = 394)
Age, y					
<30	2706 (5.6)	82 (8.8)	13 (5.2)	7 (13.5)	30 (7.6)
30-40	5886 (12.2)	146 (15.7)	30 (12.0)	11 (21.1)	54 (13.7)
40-50	8979 (18.7)	176 (18.9)	32 (12.8)	7 (13.5)	61 (15.5)
50-60	8924 (18.5)	167 (17.9)	44 (17.5)	10 (19.2)	70 (17.8)
60-70	8490 (17.6)	153 (16.4)	49 (19.5)	6 (11.5)	62 (15.7)
70-80	8315 (17.3)	135 (14.5)	47 (18.7)	4 (7.7)	75 (19.0)
>80	4843 (10.1)	73 (7.8)	36 (14.3)	7 (13.5)	42 (10.7)
Sex					
Male	27 017 (56.1)	424 (45.5)	124 (49.4)	25 (48.1)	190 (48.2)
Female	21 126 (43.9)	508 (54.5)	127 (50.6)	27 (51.9)	204 (51.8)
Marital status					
Married	26 037 (54.1)	518 (55.6)	90 (35.9)	25 (48.1)	212 (53.8)
Unmarried	11 989 (24.9)	323 (34.6)	128 (51.0)	14 (26.9)	121 (30.7)
Unknown	10 117 (21.0)	91 (9.8)	33 (13.2)	13 (25.0)	61 (15.5)
Year of diagnosis					
1992	3358 (7.0)	81 (8.7)	12 (4.8)	6 (11.5)	20 (5.1)
1993	3373 (7.0)	86 (9.2)	11 (4.4)	2 (3.8)	26 (6.6)
1994	3703 (7.7)	59 (6.3)	25 (10.0)	5 (9.6)	24 (6.1)
1995	4076 (8.5)	57 (6.1)	28 (11.2)	4 (7.7)	33 (8.4)
1996	4337 (9.0)	80 (8.6)	23 (9.2)	5 (9.6)	30 (7.6)
1997	4340 (9.0)	82 (8.8)	23 (9.2)	4 (7.7)	41 (10.4)
1998	4682 (9.7)	74 (7.9)	34 (13.5)	4 (7.7)	35 (8.9)
1999	4790 (9.9)	107 (11.5)	32 (12.7)	5 (9.6)	32 (8.1)
2000	5047 (10.5)	100 (10.7)	18 (7.2)	8 (15.4)	51 (12.9)
2001	5340 (11.1)	101 (10.8)	22 (8.8)	5 (9.6)	43 (10.9)
2002	5097 (10.6)	105 (11.3)	23 (9.2)	4 (7.7)	59 (15.0)
Region					
West	29 462 (61.2)	854 (91.6)	109 (43.4)	49 (94.2)	368 (93.4)
Midwest	8763 (18.2)	19 (2.0)	54 (21.5)	0	8 (2.0)
Northeast	6322 (13.1)	40 (4.3)	31 (12.4)	2 (3.8)	10 (2.5)
South	3596 (7.5)	19 (2.0)	57 (22.7)	1 (1.9)	8 (2.0)

*Data are given as number (percentage) of patients. $P<.05$ value (χ^2 test) for all comparisons.

A comparison of the clinicopathologic characteristics by race/ethnicity is summarized in **Table 2**. The truncal region was the most common primary tumor site for whites (34.0%) and American Indians (34.6%), whereas the lower extremity was the most common primary site for Hispanics (30.0%), African Americans (48.2%), and Asian/Pacific islanders (36.8%) ($P<.001$). Among the patients with histologic reports, superficial spreading was the most common histologic subtype for all groups. Acral lentiginous melanoma was more prevalent among minority populations than in whites: ORs, 5.5, 20.5, 4.1, and 11.5 for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively. Of whites, 66% presented with thin melanomas (≤1 mm thick) compared with 48.3% of Hispanics, 44.2% of African Americans, 57.7% of American Indians, and 48.7% of Asian/Pacific islanders ($P<.001$). The median tumor thickness (Breslow thickness) at presentation was 0.66 mm for whites, compared with 1.1 mm, 1.2 mm, 0.77 mm, and 1.07 mm for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively ($P<.001$). In addition, minority patients were more likely to have primary melanomas that were Clark level IV or higher, and Hispanics, African Americans, and Asian/Pacific islanders were more likely to have primary tumor ulceration ($P<.001$). Minority patients were more likely to have advanced stages of disease at presentation: 10.2% of Hispanics, 16.7% of African Americans, 15.4% of American Indians, and 9.6% of Asian/Pacific islanders presented with stage IV (distant metastatic disease) melanoma compared with only 3.9% of whites ($P<.001$).

OVERALL SURVIVAL

The Kaplan-Meier curves for overall survival stratified according to race/ethnicity are presented in **Figure 1**. These curves demonstrate that whites had better overall outcomes than other minority populations, particularly African Americans. With a median follow-up of 4.6 years, 5-year survival rates were 69.7% (95% CI, 66.1%-73.4%), 58.2% (95% CI, 51.5%-65.7%), 69.8% (95% CI, 56.7%-85.8%), and 70.9% (95% CI, 65.6%-76.5%) for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively, compared with 79.3% (95% CI, 78.8%-79.7%), for whites (log-rank, $P<.001$). The distribution of nonmelanoma causes of death were also examined in this cohort. In the 5110 patients who died of causes other than melanoma, there was no significant difference among the various ethnic groups (data not shown).

Table 2. Comparison of Clinicopathologic Characteristics Among 49 772 Patients With Invasive Melanoma According to Race/Ethnicity*

Characteristic	White (n = 48 143)	Hispanic (n = 932)	African American (n = 251)	American Indian (n = 52)	Asian/Pacific Islander (n = 394)
Anatomic site					
Upper extremity	11 609 (24.1)	179 (19.2)	34 (13.5)	6 (11.5)	74 (18.8)
Lower extremity	9367 (19.5)	279 (30.0)	121 (48.2)	12 (23.1)	145 (36.8)
Trunk	16 345 (34.0)	247 (26.5)	45 (17.9)	18 (34.6)	96 (24.3)
Head and neck	9358 (19.4)	169 (18.1)	22 (8.8)	9 (17.3)	46 (11.7)
Unknown	1464 (3.0)	58 (6.2)	29 (11.6)	7 (13.5)	33 (8.4)
Histologic subtype					
Superficial spreading	20 245 (42.1)	275 (29.5)	58 (23.1)	20 (38.5)	87 (22.1)
Nodular	4097 (8.5)	106 (11.4)	16 (6.4)	3 (5.8)	45 (11.4)
Acral lentiginous	467 (1.0)	48 (5.2)	42 (16.7)	2 (3.8)	40 (10.1)
Lentigo	3244 (6.7)	45 (4.8)	6 (2.4)	3 (5.8)	12 (3.1)
Desmoplastic	1077 (2.2)	30 (3.2)	7 (2.8)	0 (0.0)	9 (2.3)
Amelanotic	246 (0.5)	4 (0.4)	0 (0.0)	1 (1.9)	3 (0.8)
Unknown	18 767 (39.0)	424 (45.5)	122 (48.6)	23 (44.2)	198 (50.2)
Thickness					
T1 (≤1.0 mm)	31 914 (66.3)	450 (48.3)	111 (44.2)	30 (57.7)	192 (48.7)
T2 (1.01-2.0 mm)	7797 (16.2)	145 (15.6)	37 (14.7)	6 (11.5)	59 (15.0)
T3 (2.01-4.0 mm)	4318 (9.0)	137 (14.7)	32 (12.8)	4 (7.7)	50 (12.7)
T4 (>4.0 mm)	2320 (4.8)	112 (12.0)	33 (13.2)	5 (9.6)	51 (12.9)
Unknown	1794 (3.7)	88 (9.4)	38 (15.1)	7 (13.5)	42 (10.7)
Clark level					
II-III	29 600 (61.5)	449 (48.2)	96 (38.3)	24 (46.1)	164 (41.6)
IV-V	12 294 (25.5)	297 (31.9)	91 (36.2)	15 (28.9)	126 (32.0)
Unknown	6249 (13.0)	186 (19.9)	64 (25.5)	13 (25.0)	104 (26.4)
Primary tumor ulceration					
Yes	2547 (5.3)	87 (9.3)	23 (9.2)	2 (3.9)	49 (12.4)
No/unknown	45 596 (94.7)	845 (90.7)	228 (90.8)	50 (96.1)	345 (87.6)
AJCC stage[9]					
I	38 182 (79.3)	561 (60.2)	131 (52.2)	36 (69.2)	226 (57.4)
II	6032 (12.5)	183 (19.6)	55 (21.9)	8 (15.4)	82 (20.8)
III	2057 (4.3)	93 (10.0)	23 (9.2)	0 (0.0)	48 (12.2)
IV	1872 (3.9)	95 (10.2)	42 (16.7)	8 (15.4)	38 (9.6)

Abbreviation: AJCC, American Joint Committee on Cancer.
*Data are given as number (percentage) of patients. $P<.05$ (χ^2 test) for all comparisons.

DISEASE-SPECIFIC SURVIVAL

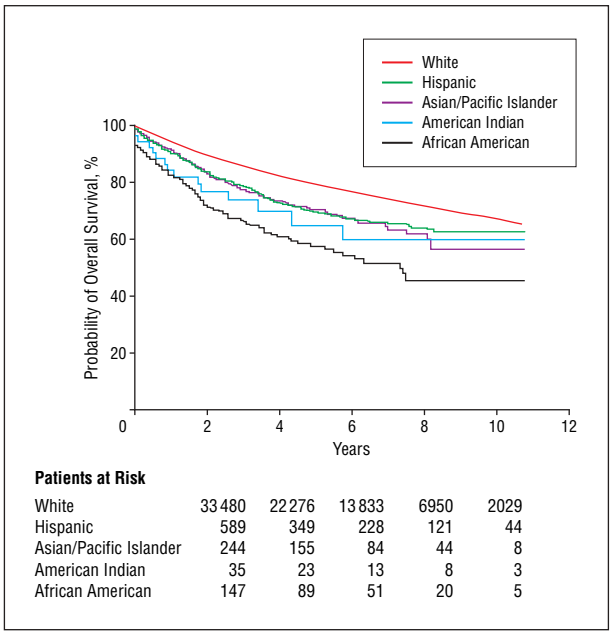
The Kaplan-Meier curves for melanoma-specific survival according to race/ethnicity are presented in **Figure 2**. These curves demonstrate that whites had better overall outcomes compared with other minority populations, particularly African Americans. Five-year survival rates were 81.1% (95% CI, 78.1%-84.3%), 72.2% (95% CI, 65.5%-79.6%), 81.0% (95% CI, 69.2%-94.9%), and 80.2% (95% CI, 75.4%-85.2%) for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively, compared with 89.6% (95% CI, 89.3%-90.0%) for whites (log-rank, $P<.001$). The stage-specific Kaplan-Meier curves for melanoma-specific survival for African Americans vs whites are presented in **Figure 3**.

To find a possible explanation for the noted differences in survival, we examined the adjusted ORs using multinomial logistic methods for patients presenting with various stages of melanoma according to race/ethnicity (**Table 3**). Compared with whites, minority populations were approximately twice as likely to present with stage II or III melanoma. Of even greater concern were the significantly higher odds of minority patients presenting with stage IV melanoma compared with those of whites (ORs, 3.6, 4.2, 3.4, and 2.4 for Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively). Other significant ($P<.001$) clinicopathologic factors associated with stage IV melanoma presentation were older age (OR, 1.1 per decade), male sex (OR, 1.5), unmarried status (OR, 1.7), and nodular (OR, 22.4) or acral lentiginous (OR, 12.8) histologic subtype.

Multivariate analyses demonstrated that after adjusting for age, sex, and region, minority populations had a 2.0- to 3.0-fold greater risk of disease-specific mortality compared with whites ($P<.001$) (**Table 4**). However, when the analysis was adjusted for disease stage at presentation and other potential confounders (eg, marital status, year of diagnosis, tumor site, and histologic characteristics), only African Americans were noted to have a statistically greater risk of disease-specific mortality compared with whites (hazard ratio, 1.5; 95% CI, 1.1-2.0). Of note, the CIs were large for American Indians and Asian/Pacific islanders, reflecting the small number of events in these groups.

COMMENT

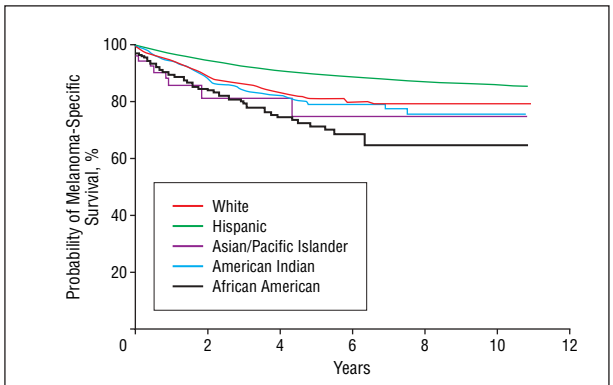
Our results confirm that cutaneous melanoma is a rare disease in minority populations, with an average annual



Patients at Risk

White	33 480	22 276	13 833	6950	2029
Hispanic	589	349	228	121	44
Asian/Pacific Islander	244	155	84	44	8
American Indian	35	23	13	8	3
African American	147	89	51	20	5

Figure 1. Kaplan-Meier curves for overall survival according to race/ethnicity.



Patients at Risk

White	33 480	22 276	13 833	6950	2029
Hispanic	589	349	228	121	44
Asian/Pacific Islander	244	155	84	44	8
American Indian	35	23	13	8	3
African American	147	89	51	20	5

Figure 2. Kaplan-Meier curves for melanoma-specific survival according to race/ethnicity.

age-adjusted incidence of 2.3, 0.8, 1.6, and 1.0 per 100 000 persons in Hispanics, African Americans, American Indians, and Asian/Pacific islanders, respectively. An estimated annual percentage increase in melanoma incidence of 5.0% was noted for whites ($P<.001$) and 6.1% for Asian/Pacific islanders ($P=.002$). Although the disease is known to be less common in African Americans, those diagnosed as having cutaneous melanoma have been reported to have poorer overall survival compared with whites.[4-6,14,15] Our findings expand on these studies by providing data that include 5 main categories of race/ethnicity in a large, multisite, population-based setting with disease-specific outcomes. We demonstrated that the lower survival rates among minorities are in part due to their having more advanced stages of disease at presentation compared with whites.

It has become well established over the past decade that a disproportionate number of cancer deaths in the United States occur among racial/ethnic minorities, particularly African Americans.[16,17] Potential explanations for these disparities in cancer outcomes include more advanced disease stage at presentation,[18-26] more aggressive tumor biological behavior,[26-28] differences in treatment,[29] and socioeconomic status,[30-33] which includes lifestyle behaviors, social environment, and access to health care services.[16,34-36] To date, however, racial disparities with respect to melanoma outcomes have received limited attention.[6,37-39] All minority populations in this study, including Hispanics (OR, 3.6), African Americans (OR, 4.2), American Indians (OR, 3.4), and Asian/Pacific islanders (OR, 2.4), were more likely to have stage IV melanoma at the time of presentation than were whites. When outcomes were examined by stage, differences persisted only between African Americans and whites, with a 1.48-fold increase in risk-adjusted, stage-specific mortality for African Americans.

Previous reports of outcomes in patients with melanoma have been conflicting, with Reintgen et al[40] reporting differences in stage-specific melanoma outcomes between African Americans and whites and, more recently, Hemmings et al,[6] reporting no differences in outcomes in nonwhite vs white patients who were stratified by stage at initial diagnosis. Poorer cancer survival outcomes among minority populations for a variety of solid tumors, including breast,[25] lung,[41] esophageal,[29,42] head and neck,[26] and prostate cancers,[19-24] have been attributed to advanced cancer stage at presentation. Franke et al[43] attributed the poorer prognosis of acral lentiginous melanomas to a delay in diagnosis and reported mean times for patient delay and physician delay of 4.8 years and 7 months, respectively. Given the atypical location of these lesions and the lack of awareness of this disease entity in minority populations, physician misdiagnosis has been reported as a common occurrence, further delaying potentially curative surgical treatment.[44,45]

Given the clinical heterogeneity of melanoma with respect to anatomic distribution and histologic subtypes in various race/ethnic groups, it has been postulated that there may be biological differences caused by genetically distinct types of melanoma.[46] In support of this concept, shorter survival has been reported with nodular and acral lentiginous melanomas, which are known to be more common in minority populations.[4] In the present analysis, superficial spreading melanoma was the predominant histologic subtype identified among all populations. Although the incidence of acral lentiginous melanoma was greater in minority populations (5%-17% vs 1% in whites), it still represents an uncommon histologic subtype overall. In addition, outcomes based on histologic subtype and stratified by race/ethnicity were similar (data not shown), and multivariate analyses, which controlled for both histologic subtype and disease stage at presentation, continued to demonstrate a significantly increased risk of death (hazard ratio, 1.5; 95% CI, 1.1-2.0) for African Americans compared with whites, indicating that histologic subtype alone was not an independent prognostic factor for outcome.

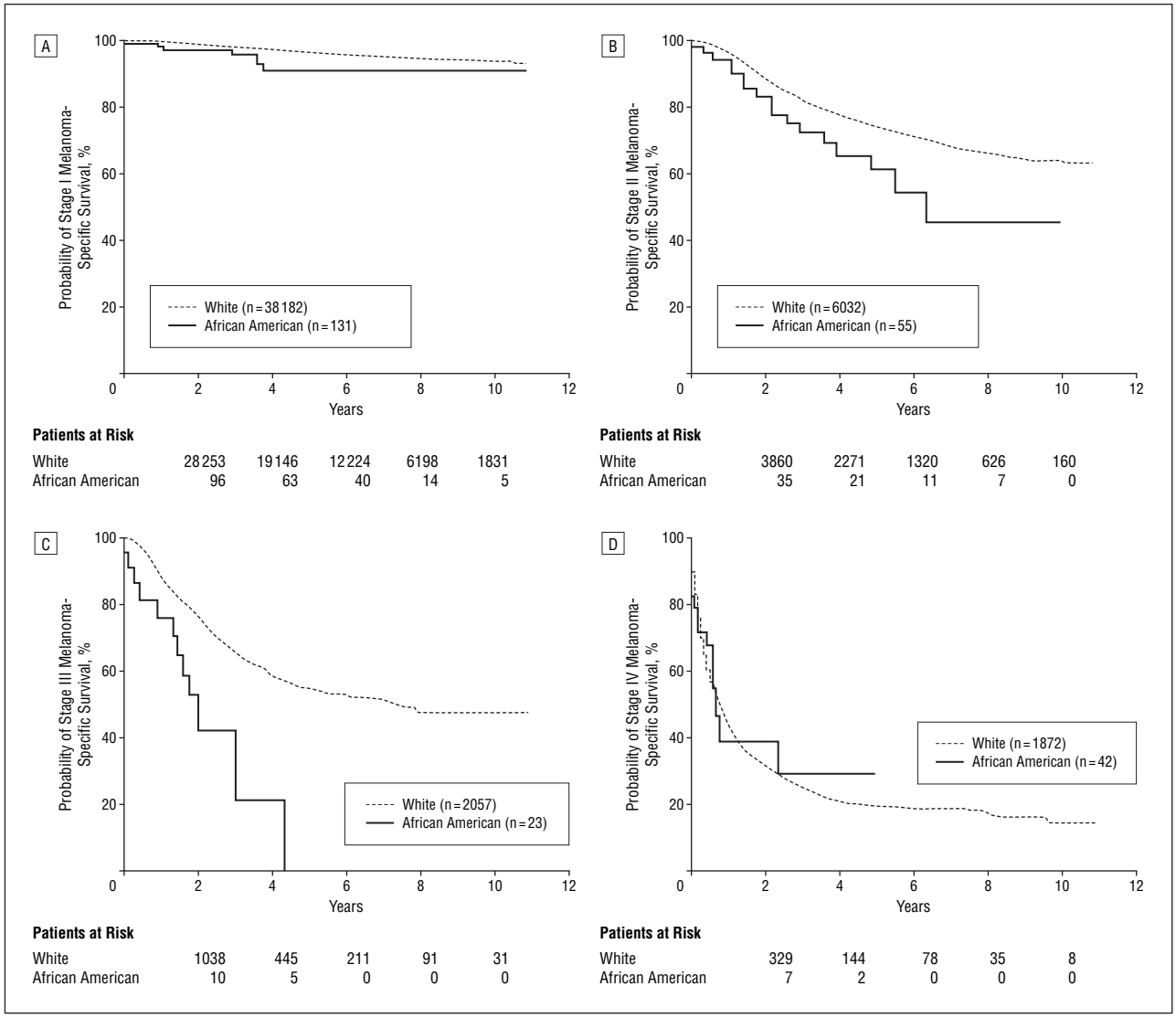


Figure 3. Stage I (A), stage II (B), stage III (C), and stage IV (D) melanoma-specific survival for African Americans vs whites.

Table 3. Adjusted ORs for Disease Stage at Presentation According to Race/Ethnicity

	AJCC Stage[9]					
	Stage II		Stage III		Stage IV	
Race/Ethnicity	OR* (95% CI)	*P* Value	OR* (95% CI)	*P* Value	OR* (95% CI)	*P* Value
White	1.00		1.00		1.00	
Hispanic	1.95 (1.62-2.35)	<.001	2.40 (1.89-3.05)	<.001	3.64 (2.65-5.00)	<.001
African American	1.97 (1.39-2.80)	<.001	2.06 (1.28-3.32)	.003	4.24 (2.49-7.22)	<.001
American Indian	1.81 (0.79-4.19)	.16	. . .	. . .	3.38 (0.84-13.59)	.09
Asian/Pacific Islander	1.99 (1.50-2.64)	<.001	2.78 (1.97-3.91)	<.001	2.36 (1.39-4.00)	.001

Abbreviations: AJCC, American Joint Committee on Cancer; CI, confidence interval; OR, odds ratio; ellipses, no patients in this category.
*All ORs are adjusted for age, sex, marital status, year of diagnosis, region, anatomic site, and histologic subtype using multinomial logistic regression. Whites served as the reference race and ethnicity, and stage I served as the baseline AJCC stage.

Racial disparities in the use of cancer-directed treatments, including surgery, radiation therapy, and chemotherapy, for a variety of malignancies have been well-documented; in particular, African Americans have been shown to be given less than optimal care.[16,29,41,47-51] Our group has previously reported that there were no significant differences between African Americans and whites with respect to melanoma treatment.[52]

Our study has a number of strengths. First, it is a population-based study, covering incident cases of

Table 4. Risk of Mortality From Melanoma According to Race/Ethnicity

Race/Ethnicity	No. of Patients at Risk	No. of Events	Hazard Ratio (95% CI)	
			Adjusted for Age, Sex, and SEER Registry Only	Adjusted for Age, Sex, SEER Registry, Marital Status, Year of Diagnosis, Anatomic Site, Histologic Subtype, and Stage
White	48 143	4102	1.00	1.00
Hispanic	932	130	1.96 (1.64-2.34)	1.03 (0.96-1.24)
African American	251	54	3.01 (2.30-3.94)	1.48 (1.13-1.96)
American Indian	52	9	2.60 (1.35-5.01)	1.34 (0.69-2.60)
Asian/Pacific Islander	394	58	2.17 (1.65-2.84)	1.30 (0.99-1.70)

Abbreviations: CI, confidence interval; SEER, Surveillance, Epidemiology, and End Results.

melanoma in 11 SEER regions that accounted for 14% of the US population during the study period. The cases in this large cohort were pathologically confirmed and identified by the SEER registries, one of the most authoritative data sources for cancer. The SEER registries provide reliable information on tumor thickness, nodal status, surgical treatment, and long-term follow-up.[15,18] These data allowed us to estimate the incidence, distribution, and outcomes attributable to an uncommon disease, namely cutaneous melanoma in minority populations. The rarity of melanoma in these populations has been previously described[4-6]; however, accurate population-based estimates of the anatomic distribution, histologic subtypes, and overall outcomes have not been reported.

In interpreting the results of this study, it is important to acknowledge that there was a lack of information regarding some factors that may be associated with melanoma stage at presentation and differences in mortality rates. Specifically, data on socioeconomic status, comorbid conditions, and access to health care are not available in SEER. This is important because socioeconomic status has been implicated as the primary factor contributing to disparities in cancer outcomes among various ethnic groups in patients with breast cancer,[25,53,54] prostate cancer,[27,55-58] lung cancer,[41] head and neck cancer,[26] and esophageal cancer.[29,42] However, the results of additional reports examining the impact of socioeconomic status on cancer outcomes are mixed,[27,31,42,59-61] possibly indicating that the variety of measures used to estimate socioeconomic status are inaccurate or crude.[32]

On the basis of our study, we conclude that melanoma is an ever-increasing public health concern for minority populations as well as whites in the United States. A combination of tumor characteristics and possibly socioeconomic factors—and not treatment factors—likely contribute to the differences in stage at melanoma presentation and survival rates by race/ethnicity. Understanding these differences is of public health importance because increasing awareness of this disease among minority populations may provide an opportunity for early detection and ultimately save lives. Efforts to increase melanoma awareness should include educational programs developed for primary care physicians and patients that include the unique features of melanoma in minority patients to successfully provide screening for early detection in people of all ethnic backgrounds.

Accepted for Publication: May 31, 2006.
Correspondence: Janice N. Cormier, MD, MPH, Department of Surgical Oncology, Unit 444, The University of Texas M. D. Anderson Cancer Center, 1515 Holcombe Blvd, PO Box 301402, Houston, TX 77230-1402 (jcormier@mdanderson.org).
Financial Disclosure: None reported.
Funding/Support: This study was funded by grant 5-K12-CA088084 from the Clinical Oncology Research Development Program, National Cancer Institute.
Previous Presentation: This study was presented at the Sixth World Congress on Melanoma; September 8, 2005; Vancouver, British Columbia.
Acknowledgment: We thank Dawn Chalaire, BA, for her editorial assistance and Orlean Smith, BS, for manuscript preparation.

REFERENCES

1. Gandini S, Sera F, Cattaruzza MS, et al. Meta-analysis of risk factors for cutaneous melanoma, II: sun exposure. *Eur J Cancer*. 2005;41:45-60.
2. Cockburn MG, Zadnick J, Deapen D. Developing epidemic of melanoma in the Hispanic population of California. *Cancer*. 2006;106:1162-1168.
3. Chen YJ, Wu CY, Chen JT, Shen JL, Chen CC, Wang HC. Clinicopathologic analysis of malignant melanoma in Taiwan. *J Am Acad Dermatol*. 1999;41:945-949.
4. Chang AE, Karnell LH, Menck HR; The American College of Surgeons Commission on Cancer and the American Cancer Society. The National Cancer Data Base report on cutaneous and noncutaneous melanoma: a summary of 84,836 cases from the past decade. *Cancer*. 1998;83:1664-1678.
5. Cress RD, Holly EA. Incidence of cutaneous melanoma among non-Hispanic whites, Hispanics, Asians, and blacks: an analysis of California cancer registry data, 1988-93. *Cancer Causes Control*. 1997;8:246-252.
6. Hemmings DE, Johnson DS, Tominaga GT, Wong JH. Cutaneous melanoma in a multiethnic population: is this a different disease? *Arch Surg*. 2004;139:968-972.
7. US Census Bureau. US interim projections by age, sex, race, and Hispanic origin. Washington, DC: US Census Bureau; 2004. http://www.census.gov/ipc/www/usinterimproj/. Accessed August 8, 2005.
8. National Cancer Institute. Surveillance, Epidemiology and End Results: SEER Site recode ICD-O-3 (1/27/2003) definition. Bethesda, Md: National Cancer Institute. http://seer.cancer.gov/siterecode/icdo3_d01272003/. Accessed February 28, 2006.
9. Greene FL; American Joint Committee on Cancer, American Cancer Society. *Melanoma of the Skin: AJCC Cancer Staging Handbook: From the AJCC Cancer Staging Manual*. 6th ed. New York, NY: Springer; 2002:239.
10. Kaplan EL, Meier P. Nonparametric estimator from incomplete observations. *J Am Stat Assoc*. 1958;53:457-481.
11. Mantel N. Evaluation of survival data and two new rank order statistics arising in its consideration. *Cancer Chemother Rep*. 1966;50:163-170.
12. Cox DR. Regression models and life tables. *J R Stat Soc Ser A*. 1972;B34:187-220.

13. Breslow NE, Day NE. Statistical methods in cancer research: volume I—the analysis of case-control studies. *IARC Sci Publ*. 1980;(32):5-338.
14. Thompson JF, Morton DL, Kroon BB. *Textbook of Melanoma*. London, England: Martin Dunitz Taylor & Francis Group; 2004.
15. Jemal A, Clegg LX, Ward E, et al. Annual report to the nation on the status of cancer, 1975-2001, with a special feature regarding survival. *Cancer*. 2004; 101:3-27.
16. Shavers VL, Brown ML. Racial and ethnic disparities in the receipt of cancer treatment. *J Natl Cancer Inst*. 2002;94:334-357.
17. Guidry JJ, Torrence W, Herbelin S. Closing the divide: diverse populations and cancer survivorship. *Cancer*. 2005;104(11)(suppl):2577-2583.
18. Ries LAG, Eisner MP, Kosary CL, et al. SEER cancer statistics Review, 1975-2002. Bethesda, Md: National Cancer Institute; 2005. http://seer.cancer.gov/csr/1975_2002/. Accessed May 25, 2005.
19. Morton RA Jr. Racial differences in adenocarcinoma of the prostate in North American men. *Urology*. 1994;44:637-645.
20. Hoffman RM, Gilliland FD, Eley JW, et al. Racial and ethnic differences in advanced-stage prostate cancer: the Prostate Cancer Outcomes Study. *J Natl Cancer Inst*. 2001;93:388-395.
21. Demark-Wahnefried W, Schildkraut JM, Iselin CE, et al. Treatment options, selection, and satisfaction among African American and white men with prostate carcinoma in North Carolina. *Cancer*. 1998;83:320-330.
22. Brawn PN, Johnson EH, Kuhl DL, et al. Stage at presentation and survival of white and black patients with prostate carcinoma. *Cancer*. 1993;71: 2569-2573.
23. Natarajan N, Murphy GP, Mettlin C. Prostate cancer in blacks: an update from the American College of Surgeons' patterns of care studies. *J Surg Oncol*. 1989; 40:232-236.
24. Optenberg SA, Thompson IM, Friedrichs P, Wojcik B, Stein C, Kramer BS. Race, treatment, and long-term survival from prostate cancer in an equal-access medical care delivery system. *JAMA*. 1995;274:1599-1605.
25. Li CI, Malone KE, Daling JR. Differences in breast cancer stage, treatment, and survival by race and ethnicity. *Arch Intern Med*. 2003;163:49-56.
26. Shavers VL, Harlan LC, Winn D, Davis WW. Racial/ethnic patterns of care for cancers of the oral cavity, pharynx, larynx, sinuses, and salivary glands. *Cancer Metastasis Rev*. 2003;22:25-38.
27. Freedland SJ, Isaacs WB. Explaining racial differences in prostate cancer in the United States: sociology or biology? *Prostate*. 2005;62:243-252.
28. Hofmann U, Szedlak M, Rittgen W, Jung EG, Schadendorf D. Primary staging and follow-up in melanoma patients–monocenter evaluation of methods, costs and patient survival. *Br J Cancer*. 2002;87:151-157.
29. Steyerberg EW, Earle CC, Neville BA, Weeks JC. Racial differences in surgical evaluation, treatment, and outcome of locoregional esophageal cancer: a population-based analysis of elderly patients. *J Clin Oncol*. 2005;23:510-517.
30. Polednak AP. Prostate cancer treatment in African American and Caucasian men: the need to consider both stage at diagnosis and socioeconomic status. *J Natl Med Assoc*. 1998;90:101-104.
31. Howard G, Anderson RT, Russell G, Howard VJ, Burke GL. Race, socioeconomic status, and cause-specific mortality. *Ann Epidemiol*. 2000;10:214-223.
32. Ward E, Jemal A, Cokkinides V, et al. Cancer disparities by race/ethnicity and socioeconomic status. *CA Cancer J Clin*. 2004;54:78-93.
33. Neal RD, Allgar VL. Sociodemographic factors and delays in the diagnosis of six cancers: analysis of data from the National Survey of NHS Patients: Cancer. *Br J Cancer*. 2005;92:1971-1975.
34. Bach PB, Guadagnoli E, Schrag D, Schussler N, Warren JL. Patient demographic and socioeconomic characteristics in the SEER-Medicare database applications and limitations. *Med Care*. 2002;40(8)(suppl):IV-19-IV25.
35. Ayanian JZ, Chrischilles EA, Wallace RB, et al. Understanding cancer treatment and outcomes: the cancer care outcomes research and surveillance consortium. *J Clin Oncol*. 2004;22:2992-2996.
36. Williams DR, Neighbors HW, Jackson JS. Racial/ethnic discrimination and health: findings from community studies. *Am J Public Health*. 2003;93:200-208.
37. Rahman Z, Taylor SC. Malignant melanoma in African Americans. *Cutis*. 2001;67: 403-406.
38. Harrison RA, Haque AU, Roseman JM, Soong SJ. Socioeconomic characteristics and melanoma incidence. *Ann Epidemiol*. 1998;8:327-333.
39. Kirsner RS, Wilkinson JD, Ma F, Pacheco H, Federman DG. The association of Medicare health care delivery systems with stage at diagnosis and survival for patients with melanoma. *Arch Dermatol*. 2005;141:753-757.
40. Reintgen DS, McCarty KM, Cox E, Seigler HF. Malignant melanoma in black American and white American populations. *JAMA*. 1982;248:1856-1859.
41. Bach PB, Cramer LD, Warren JL, Begg CB. Racial differences in the treatment of early—stage lung cancer. *N Engl J Med*. 1999;341:1198-1205.
42. Miller JAG, Rege RV, Ko CY, Livingston EH. Health care access and poverty do not explain the higher esophageal cancer mortality in African Americans. *Am J Surg*. 2004;188:22-26.
43. Franke W, Neuman N, Ruzicka T, Schulte K. Planta malignant melanoma: a challenge for early recognition. *Melanoma Res*. 2000;10:571-576.
44. Bennett DR, Wasson D, MacArthur JD, McMillen MA. The effect of misdiagnosis and delay in diagnosis on clinical outcome in melanomas of the foot. *J Am Coll Surg*. 1994;179:279-284.
45. Kato T, Suetake T, Sugiyama Y, et al. Improvement in survival rate of patients with acral melanoma observed in the past 22 years in Sendai, Japan. *Clin Exp Dermatol*. 1993;18:107-110.
46. Curtin JA, Fridlyand J, Kageshita T, et al. Distinct sets of genetic alterations in melanoma. *N Engl J Med*. 2005;353:2135-2147.
47. Ayanian JZ, Zaslavsky AM, Fuchs CS, et al. Use of adjuvant chemotherapy and radiation therapy for colorectal cancer in a population-based cohort. *J Clin Oncol*. 2003;21:1293-1300.
48. O'Malley CD, Le GM, Glaser SL, Shema SJ, West DW. Socioeconomic status and breast carcinoma survival in four racial/ethnic groups. *Cancer*. 2003;97: 1303-1311.
49. Konety BR, Joslyn SA. Factors influencing aggressive therapy for bladder cancer: an analysis of data from the SEER program. *J Urol*. 2003;170:1765-1771.
50. Godley PA, Schenck AP, Ahinee M, et al. Racial differences in mortality among Medicare recipients after treatment for localized prostate cancer. *J Natl Cancer Inst*. 2003;95:1702-1710.
51. Haggstrom DA, Quale C, Smith-Bindman R. Differences in the quality of breast cancer care among vulnerable populations. *Cancer*. 2005;104:2347-2358.
52. Cormier JN, Xing Y, Ding M, et al. Population-based assessment of surgical treatment trends for patients with melanoma in the era of sentinel lymph node biopsy. *J Clin Oncol*. 2005;23:6054-6062.
53. Perkins P, Cooksley CD, Cox JD. Breast cancer: is ethnicity an independent prognostic factor for survival? *Cancer*. 1996;78:1241-1247.
54. Ansell D, Whitman S, Lipton R, Cooper R. Race, income, and survival from breast cancer at two public hospitals. *Cancer*. 1993;72:2974-2978.
55. Bennett CL, Ferreira MR, Davis TC, et al. Relation between literacy, race, and stage of presentation among low-income patients with prostate cancer. *J Clin Oncol*. 1998;16:3101-3104.
56. Roetzheim RG, Pal N, Tennant C, et al. Effects of health insurance and race on early detection of cancer. *J Natl Cancer Inst*. 1999;91:1409-1415.
57. Vijayakumar S, Weichselbaum R, Vaida F, Dale W, Hellman S. Prostate-specific antigen levels in African-Americans correlate with insurance status as an indicator of socioeconomic status [abstract]. *Cancer J Sci Am*. 1996;2:225.
58. Conlisk EA, Lengerich EJ, Demark-Wahnefried W, Schildkraut JM, Aldrich TE. Prostate cancer: demographic and behavioral correlates of stage at diagnosis among blacks and whites in North Carolina. *Urology*. 1999;53:1194-1199.
59. Bradley CJ, Given CW, Roberts C. Race, socioeconomic status, and breast cancer treatment and survival. *J Natl Cancer Inst*. 2002;94:490-496.
60. Yood MU, Johnson CC, Blount A, et al. Race and differences in breast cancer survival in a managed care population. *J Natl Cancer Inst*. 1999;91:1487-1491.
61. Tarman GJ, Kane CJ, Moul JW, et al. Impact of socioeconomic status and race on clinical parameters of patients undergoing radical prostatectomy in an equal access health care system. *Urology*. 2000;56:1016-1020.