Objective: To examine and compare the temporal trends in melanoma incidence and stage at diagnosis among whites, Hispanics, and blacks in Florida from 1990 to 2004.

Design: Cross-sectional and retrospective analysis.

Setting: Florida Cancer Data System.

Patients: Melanoma cases with known stage and race/ethnicity reported from 1990 to 2004.

Main Outcome Measures: Age-adjusted melanoma incidence and stage at diagnosis.

Results: Of 41,072 cases of melanoma, 39,670 cases were reported for white non-Hispanics (WNHs), 1,148 for white Hispanics (WHs), and 254 for blacks. Melanoma incidence rates increased by 3.0% per year among WNH men (P = .001), 3.6% among WNH women (P = .001), 3.4% among WH women (P = .01), and 0.9% among WH men (P = .52), while remaining relatively stable among black men and women. Both WHs and blacks had significantly more advanced melanoma at presentation: 18% of WH and 26% of black patients had either regional or distant-stage melanoma at diagnosis compared with 12% of WNH patients. The proportion of distant-stage melanoma diagnosed among WHs and blacks changed little from 1990 to 2004, compared with a steady decrease in the percentage of melanoma cases diagnosed at distant stage among WNHs (P < .001). Such differences in the time trends of the proportion of distant-stage melanoma remained after excluding in situ cases.

Conclusions: The rising melanoma incidence among WNHs and WHs emphasizes the need for primary prevention. The persistence of disparity in melanoma stage at diagnosis among WHs, blacks, and WNHs warrants closer examination of secondary prevention efforts in minority groups.

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Melanoma is among the top 10 new cancer diagnoses for both American men and women. Nationally, melanoma incidence has increased 2.4% annually in the last decade. Research and public education efforts have focused on melanoma prevention in white populations because of their higher risk of developing melanoma. Improved secondary prevention measures with earlier detection of thin (early-stage) melanoma likely account for the improved survival among whites from 68% in the early 1970s to 92% in recent years. Such advances, however, have not occurred in other racial and ethnic groups in the United States. Emerging data call attention to disparity in melanoma diagnosis and survival in minorities such as Hispanics and blacks. Multiple reports found that US blacks have more advanced melanoma in association with worse survival rates; however, melanoma disparity among Hispanics is less recognized. The dearth of studies on melanoma among Hispanics partly reflects the small number of cases in many areas of the United States, as well as limitations of ethnicity information in cancer registries. In fact, the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program and most other cancer registries did not begin classifying data for “Hispanic” until the late 1990s. As a result, few studies included data regarding Hispanics.

Florida offers unique advantages for conducting epidemiologic studies on melanoma among minority populations because of the availability of longitudinal data on Hispanics since 1981 from its state-
wide cancer incidence registry, the Florida Cancer Data System (FCDS) and its large population and volume of reported cancer cases. Florida is the second among states for melanoma incidence (4430), accounting for 7% of all cases in the United States. Florida is among the top 5 US states with the largest Hispanic populations and also has a black population that is higher than the national average. In one of the largest studies of melanoma among Hispanics, using data from the FCDS, we previously reported that a greater proportion of Hispanics (26%) had late-stage diagnoses compared with white non-Hispanics (WNHs) (16%) in Miami-Dade County, Florida (P < .001). In a separate publication, we reported that almost half of black patients (48%) presented with either regional or distant stage melanoma compared with 22% of WNH patients in Miami-Dade County.

In the present study, we evaluated the time trend in melanoma incidence and stage at diagnosis of melanoma in 3 mutually exclusive racial/ethnic groups: white Hispanics (WHs), WNHs, and non-Hispanic blacks (hereafter referred to as "blacks") from 1990 to 2004 in Florida. We hypothesized that age-adjusted incidence rates for melanoma among WNHs and WHs in Florida increased over the past 15 years, while rates among blacks likely changed little, similar to trends observed by the SEER program. Based on our studies in Miami-Dade County, we hypothesized that both WHs and blacks will have more advanced stage melanoma at diagnosis compared with WNH, with very little improvement in melanoma diagnosis in the past 15 years.

**METHODS**

**CANCER DATA SOURCE**

Melanoma data were extracted from the FCDS, Florida’s statewide, population-based cancer incidence registry. The FCDS is a high-quality registry. It has met or exceeded the North American Association of Central Cancer Registries (NAACCR) standards of quality, timeliness, and completeness for all years since 1995, the first year in which certification was available. External estimates designate FCDS completeness percentage to be greater than 95% (as determined by external quality control audits). Stage at diagnosis is coded according to the sum of stage categories (S), site (T), and grade of malignancy, if known. The SEER Program defines stage categories as follows: in situ, local, regional, and distant. For analyses, melanomas were classified as in situ, local, regional, or distant. The Statistical Package for Social Sciences (SPSS) version 12.0 was used to analyze the data. Joinpoint Regression Program version 3.0 (Statistical Research and Applications Branch, National Cancer Institute, Bethesda, Maryland) was used to calculate annual percent change (APC), with P ≤ 0.05 considered significant for temporal trends in the annual age-adjusted melanoma incidence. To determine the statistical significance of a disparity in advanced melanoma stage at presentation among WHs and blacks compared with WNHs, we used Pearson χ² test for independence to compare the proportion of distant stage melanoma at diagnosis by race/ethnicity from 1990 to 2004.

**DATA SELECTION**

The FCDS reports Hispanic ethnicity as a separate data element from race. As a result, the 2 data elements, race and Hispanic origin, can be examined in mutually exclusive racial/ethnic groups. In this study, we examined WNHs, blacks, and WHs. Since there are very few melanoma cases classified as both black and Hispanic, we excluded them from our analysis. Race and Hispanic ethnicity are assigned based on information from a patient’s medical record or death certificate. For cases reported without Hispanic origin information, Hispanic ethnicity is imputed using a standard algorithm based on surname or maiden name from computer-generated matches of a patient’s surname to a standard list of Spanish surnames.

Unduplicated primary cutaneous melanoma cases with the International Classification of Diseases for Oncology, Version 3 (ICD-O-3) site codes C430 to C439 and histologic codes 8720 to 8790, Florida resident at time of diagnosis, and diagnosed between 1990 and 2004 were selected. Cases with unknown sex, race/ethnicity, or stage information were excluded. Annual melanoma incidence rates for invasive melanoma (excluding in situ) were age adjusted to the 2000 US Standard Population, and stratified by race/ethnicity and sex. The proportions of melanomas diagnosed at each stage within each population (WNHs, WHs, and blacks) were calculated for the entire 15-year period (1990-2004) and for 1990 to 1994, 1995 to 1999, and 2000 to 2004.

**RESULTS**

From 1990 to 2004, 41 078 melanoma cases with known race/ethnicity and stage information were reported to the FCDS, only 6 of which (1 in situ and 5 local-stage melanoma) were classified for black Hispanics and excluded from our analysis. Thus, our study included 41 072 cases; 39 670 cases (30 413 invasive melanomas) were reported for WNHs, 1148 (897 invasive) for WHs, and 254 (220 invasive) for blacks (Table 1).

**TEMPORAL TRENDS IN THE INCIDENCE OF INVASIVE MELANOMA**

We calculated APC in melanoma incidence by race/ethnicity and sex. In general, melanoma incidence is highest among WNHs, then WHs, and lowest among blacks. Temporal trends are shown in Figure 1 for men and in Figure 2 for women. Both WNH and WH men and women experienced rising melanoma rates. From 1990 to 1994, WNH women had the highest rate of annual increase (3.6%; 95% confidence interval [CI], 2.4% to 4.8%; P < .001). Findings from Joinpoint regression analysis showed that such upward trend had not changed since 1990. Melanoma incidence also increased significantly...
by 3.0% per year (95% CI, 2.2% to 3.8%; \( P < .001 \)) among WNH men. Similar to WNH women, WH women also experienced a significant increase in their melanoma incidence of 3.4% per year (95% CI, 0.9% to 6.4%; \( P = .01 \)). There was a slight increase in melanoma incidence of 0.89% per year among WH men, although not statistically significant (95% CI, −2.0% to 3.8%; \( P = .52 \)). None of these increasing trends over time showed any signs of stabilization (or slowing) based on Joinpoint regression analysis. Among blacks, melanoma incidence remained relatively stable from 1990 to 2004; we did not observe any meaningful changes over the study interval.

### COMPARISON OF OVERALL MELANOMA STAGE AT DIAGNOSIS

Over the entire 15-year period, significant differences (\( P < .001 \)) in melanoma stage at diagnosis were found among WNHs, WHs, and blacks (Table 1). Blacks had the highest proportion of melanomas diagnosed at advanced stage: 26.4% of blacks presented with either regional- or distant-stage melanoma (\( P < .001 \)). White Hispanic patients also had significantly higher proportion of regional- or distant-stage melanoma compared with WNH patients (17.8% vs 11.6%; \( P < .001 \)). Using WNHs as the reference group, we found that blacks and WHs had an odds ratio of 2.7 (95% CI, 2.0 to 3.6), and 1.6 (95% CI, 1.4 to 1.9), respectively, of having regional- or distant-stage melanoma compared with WNHs.

### TEMPORAL TREND IN MELANOMA STAGE AT DIAGNOSIS INCLUSIVE OF IN SITU CASES

Two sets of analyses were performed to compare the longitudinal trend in melanoma stage at diagnosis among the 3 study populations over 3 five-year intervals: 1990 to 1994, 1995 to 1999, and 2000 to 2004 (Table 2). In the first analysis, cases of melanoma in situ were included, and the proportions of melanoma cases diagnosed at each of the 4 stages were calculated based on the total of 39 670 cases in WNHs, 1148 cases in WHs, and 254 cases in blacks. Overall, WNHs had the highest proportions of their melanomas diagnosed at in situ stage, followed by WHs and then blacks. The proportion of melanoma in situ increased steadily and significantly for all 3 populations from 1990 to 2004 (\( P < .001 \) for WNHs, WHs, and blacks). Interestingly, when data for local-stage and in situ melanoma were combined, the proportion of melanoma diagnosed at distant stage, we observed that WNH

### Table 1. Distribution of Melanoma Incident Cases by Race/Ethnicity and Stage at Diagnosis: Florida, 1990-2000

<table>
<thead>
<tr>
<th>Stage at Diagnosis</th>
<th>White Non-Hispanic</th>
<th>White Hispanic</th>
<th>Black</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>In situ</td>
<td>9257 (23.3)</td>
<td>251 (21.9)</td>
<td>34 (13.4)</td>
<td>9542 (23.2)</td>
</tr>
<tr>
<td>Local</td>
<td>25783 (65.0)</td>
<td>692 (60.3)</td>
<td>153 (60.2)</td>
<td>26 628 (64.8)</td>
</tr>
<tr>
<td>Regional</td>
<td>2804 (7.1)</td>
<td>107 (9.3)</td>
<td>30 (11.8)</td>
<td>2941 (7.2)</td>
</tr>
<tr>
<td>Distant</td>
<td>1826 (4.5)</td>
<td>98 (8.5)</td>
<td>37 (14.6)</td>
<td>1961 (4.8)</td>
</tr>
<tr>
<td>Total</td>
<td>39 670 (100)</td>
<td>1148 (100)</td>
<td>254 (100)</td>
<td>41 072 (100)</td>
</tr>
</tbody>
</table>

\( ^a \) Source: Florida Cancer Data System.  
\( ^b \) Percentages may not total to 100 owing to rounding.
patients experienced a steady reduction in the proportion of distant-stage melanoma from 7.1% to 3.4% between 1990 and 2004 (P < .001). The proportion of distant-stage melanoma diagnosed among WH and black patients decreased somewhat in the more recent years, but overall, the decline did not reach statistical significance (P = .08 for both WHs and blacks).

TEMPORAL TREND IN MELANOMA STAGE AT DIAGNOSIS EXCLUDING IN SITU CASES

In the second set of analysis, we excluded melanoma in situ and plotted the temporal trends in the proportion of melanoma diagnosed at local and distant stage using percentages based on a total of 30413 cases for WNHs, 897 cases for WHs, and 220 cases for blacks (Table 2). In contrast to the increasing trend in melanoma in situ seen with the previous analysis, the proportions of melanoma diagnosed at local stage in all 3 populations changed very little from 1990 to 2004. However, similar to the analysis inclusive of in situ cases, we observed again a steady and significant reduction in the proportion of melanoma diagnosed at distant stage among WNHs from 8.2% to 4.8% (P = .01). For WH and black patients, there appears to be more of a reduction in the proportion of distant-stage melanoma in the more recent years, while overall, no significant decreasing trend was observed (P = .27 for WH and P = .20 for blacks).

Melanoma among darker-skinned populations has received little attention, partly reflecting their overall lower risk compared with WHNs. The lowest survival rates and delayed melanoma diagnosis is often seen in blacks. With the readily expanding population and increasing melanoma rate of 2.9% per year (P < .05), melanoma among Hispanics also becomes an increasingly important public health issue. Most of the studies on melanoma in Hispanics have used data from the SEER program or California Cancer Registry, which is a participant of the SEER program. In this study, using data from FCDS from 1990 to 2004, we further characterize the epidemiologic aspects of melanoma among blacks and Hispanics in Florida by examining the temporal trends in melanoma incidence rates and proportion by stage. Data from the FCDS carry unique importance because Florida has a large enough number of cases among minorities, as well as a diverse Hispanic population. Moreover, our analysis of FCDS data focuses on Hispanics with a different demographic profile from those residing in states covered by the SEER program.

RISING MELANOMA INCIDENCE AMONG WHs

We found that in Florida, WNH men, WH women, and WH women experienced significant increases in melanoma incidence at annual rates of 3.0% (P < .001), 3.6% (P < .001), and 3.4% (P = .01), respectively, from 1990 to 2004. While the APCs in melanoma incidence for WNH men and women are comparable to those reported by the SEER 13 registries (3.2% for WHN men and 3.4% for WHN women from 1992 to 2005; P < .05), the APC of melanoma incidence in WHN women in Florida is much higher than that for Hispanic women covered by the SEER registries (3.4% vs 1.6%). Interestingly, both WH men in our study and in the SEER registries have only slight increases in melanoma rates (Florida: APC of 0.9%; SEER: APC of 1.3%). The sharper rise in melanoma rates among WH women compared with WH men, both in Florida and nationally, may be due to inherent behavioral risk profiles by gender such as recreational sun exposure. Longer follow-up would be needed to evaluate a potential time lag in melanoma diagnosis and reporting among WH men. The overall rising melanoma incidence rates among WHs, particularly WH women, and among WNHs suggest that primary prevention of melanoma in these populations needs to be emphasized.

DISPARITIES IN MELANOMA STAGE AT DIAGNOSIS

Despite their lower melanoma rates, both WHs and blacks in Florida are much more likely to have delayed diagnosis compared with WHNs. Other studies also found more advanced melanoma or thicker melanoma among blacks and Hispanics. Cormier et al reviewed SEER data from 1992 to 2002, with similar case numbers to our study (48143 WNHs, 932 Hispanics, and 251 blacks), and found that 10.2% of Hispanics and 16.7% blacks had melanoma with metastases at presentation compared with only 3.9% of WHNs. The similarities in the distribution of dis-

Table 2. Distribution of Stage at Diagnosis by Race/Ethnicity and 5-Year Period, Including (Incl) and Excluding (Excl) Melanoma In Situ: Florida, 1990-2004

<table>
<thead>
<tr>
<th>Stage</th>
<th>White Non-Hispanic, %</th>
<th>White Hispanic, %</th>
<th>Black, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incl In Situ</td>
<td>Excl In Situ</td>
<td>Incl In Situ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In situ</td>
<td>13.7 NA</td>
<td>20.7 NA</td>
<td>19.4 NA</td>
</tr>
<tr>
<td>Local</td>
<td>72.4 77.3 67.6 76.9</td>
<td>59.9 77.2 67.2 83.9</td>
<td>62.0 85.3 56.5 84.9</td>
</tr>
<tr>
<td>Regional</td>
<td>6.8 11.3 6.9 10.1</td>
<td>7.3 13.4 9.9 7.9</td>
<td>8.2 8.7 9.8 10.3</td>
</tr>
<tr>
<td>Distant</td>
<td>7.1 11.3 4.8 12.9</td>
<td>3.4 9.4 9.9 8.2</td>
<td>10.4 6.1 6.9 4.8</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not applicable.

a Source: Florida Cancer Data System.
tart-stage melanoma among WHs and blacks between our study (8.5% of WHs and 14.6% of blacks) and that by Cormier et al18 highlight that melanoma disparity among Hispanics and blacks is a national phenomenon.

While it is possible that melanomas in different ethnic groups are distinct diseases, it is more likely that causal factors such as socioeconomic status (SES), skin cancer awareness, and cultural and social values ultimately affect melanoma stage at diagnosis.20 For example, a lack of awareness about skin cancer risks and early signs may delay a person’s decision to seek timely medical care for suspected skin lesions. We found that WH high school students in Miami-Dade County had a significantly lower level of skin cancer knowledge and awareness compared with their non-Hispanics peers.21 When comparing Hispanics and non-Hispanics with similar access to health care, Hispanics had lower awareness of melanoma and nonmelanoma skin cancers and performed less frequent skin self-checks.10 The lack of public and health care provider education on melanoma risk and prevention may also contribute to delayed diagnosis in minority communities. Byrd et al11 commented that suboptimal public education on melanoma in black communities may likely be a major factor in its advanced presentation. Both WH and black adults have lower skin cancer screening rates by physicians compared with WHNs based on data from the National Health Interview Surveys.22 Thus, skin cancer awareness and health care provider education among minority populations represent potential areas of intervention to improve melanoma diagnosis in these populations.

LACK OF IMPROVEMENT IN LATE-STAGE DIAGNOSIS AMONG MINORITY POPULATIONS

In addition to delayed diagnosis of melanoma among Hispanics and blacks, we also found that melanoma diagnosis in these populations improved little compared with that in WHNs in Florida. To examine the temporal trend of the proportion of melanoma diagnosed at early or late stage, we performed 2 sets of analysis. In the first set of analysis that included in situ melanomas, it seems that increasing proportions of melanomas are diagnosed at in situ stage among all 3 populations over the study period. Such apparent improvement disappeared after we either combined in situ with local stage or just examined the temporal trends in the proportion of local-stage melanoma excluding in situ cases. The increase in the percentage of in situ melanomas may either reflect improved detection of “incipient” melanomas or changes in diagnostic criteria or practice of diagnosing melanoma in situ.23-26

Our analysis also points to a disparity in the temporal trends of proportion of melanoma diagnosed at distant stage among minority populations in Florida. Only WHN patients benefited from continued and significant reduction in the proportion of melanomas diagnosed at distant stage. White Hispanics and blacks appeared to have less of their total melanomas diagnosed at distant stage in the more recent years, but overall, the changes were not consistent or significant during the 15-year study period. These results clearly suggest that public education and screening efforts have successfully reduced the burden of late-stage melanoma in WHNs but have not reached other populations who already have disproportionately greater burden from late-stage melanoma.

Such disparity in the secondary prevention of melanoma among Hispanics and blacks likely contributes to disparity in melanoma outcome because melanoma survival rate is intimately related to stage at diagnosis.27 Data from the SEER program showed that the 5-year survival rates of melanoma were 69.7% (95% CI, 66.1%-73.4%) and 58.2% (95% CI, 51.5%-65.7%) for Hispanics and blacks, respectively, compared with 79.3% (95% CI, 78.8%-79.7%) for WHNs (log-rank, P < .001).18 Lower SES in minority populations also contributes to lowered melanoma survival. Although melanoma incidence is generally higher in populations with higher SES,28-30 several reports found that low SES is associated with a more advanced stage of melanoma at diagnosis.19,30-31 A study of California Cancer Registry from 1993 to 2003 found that higher SES was associated with an early stage at presentation and prolonged survival (P < .001) and that both Hispanics and blacks have significantly lower SES compared with WHNs (P < .001) in the study population.19 Interestingly, after adjusting for SES, melanoma stage, anatomic site, and treatment, only blacks continued to have a statistically significant increased risk of death compared with WHNs, while no survival differences were noted for Hispanics compared with WHNs in the adjusted analysis. Using SEER data, Cormier et al18 also confirmed that the disparity in melanoma survival between WHs compared with WHNs can be mainly explained by disparity in melanoma stage at diagnosis, while blacks still had a statistically greater risk of disease-specific mortality from melanoma compared with WHNs after adjusting for stage at presentation and other potential confounders (eg, marital status, year of diagnosis, tumor site, histologic characteristics). Perhaps differences in biological behavioral of the tumor by race contribute to worse outcome in blacks. However, these results are encouraging for Hispanics in the sense that improvement in melanoma stage at diagnosis likely will significantly reduce disparity in melanoma outcome among Hispanics.

STUDY LIMITATIONS

While our study did not examine melanoma subtype and individual patient characteristics such as skin type, our objective was to provide a cross-sectional review of the overall trend in melanoma incidence and proportion by stage at diagnosis in Florida, a state that is not covered by the SEER program. An inherent limitation of registry data are that Hispanic ethnicity is imputed based on surnames or maiden names for those cases without self-reported ethnicity; however, the quality of data on Hispanic ethnicity in the FCDS is considered extremely good. The large case number (on magnitude similar to the SEER registries) and the high percentage (>95%) of histologically confirmed cases also augments the validity of our results. Another limitation of our study relates to the likely underreporting of melanoma in situ cases. The degree of underreporting of melanoma in situ by FCDS is not known, and as the diagnosis of melanoma in situ may be problematic, we performed the trend analyses excluding in situ data.
Florida shares the national trend of rising melanoma rates among WNHs and Hispanics. White Hispanic women in Florida also have a greater increase in melanoma rate compared with that reported in the SEER registries. Our study affirms that primary prevention efforts targeting sun protection, sun-smart behavior, and skin cancer awareness needs to be emphasized and improved, especially in Hispanic communities. In Florida, both blacks and Hispanics have significantly more delayed melanoma diagnosis than WNHs. Furthermore, while WNHs have less of their total melanomas diagnosed at distant stage over the past 15 years, Hispanics and blacks continued to have significantly higher burden of advanced melanoma without significant improvement over time. The improvement in melanoma diagnosis among WNHs is encouraging, indicating that such reduction is achievable with improved public education and health care provider efforts. The results of our study should motivate the expansion of melanoma awareness and screening campaigns to the minority communities, which can ultimately alleviate the disparities in melanoma outcome in these populations.

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Author Contributions: Drs Hu and Kirsner had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Hu and Parker. Acquisition of data: Allen and Parker. Analysis and interpretation of data: Parmet, Parker, Ma, Rouhani, and Kirsner. Drafting of the manuscript: Hu, Parmet, Allen, and Parker. Critical revision of the manuscript for important intellectual content: Hu, Ma, Rouhani, and Kirsner. Statistical analysis: Parmet, Allen, Parker, Ma, and Kirsner. Obtained funding: Hu. Administrative, technical, and material support: Parker and Rouhani. Financial Disclosure: None reported.

CONCLUSIONS

REFERENCES