

Biopsy Type Disparities in Patients With Melanoma: Who Receives the Standard of Care?

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Abstract. *Background/Aim:* To analyze whether demographic and facility type characteristics cause inequality in the type of biopsy performed in patients with cutaneous melanoma. *Patients and Methods:* The skin cancer National Cancer Database was assessed. Men and women of all ages with cutaneous melanoma in situ and malignant melanoma at any stage of the disease were included. Patients were selected who underwent one of the following biopsy types: excisional, punch, shave, or incisional. Bivariate and multivariate analyses were performed. *Results:* We found that the likelihood of undergoing an excisional biopsy decreased in patients who were: Hispanic [odds ratio (OR)=0.63, confidence interval (CI)=0.55-0.71], non-White (OR=0.66, CI=0.58-0.76), older than 80 years (OR=0.77, CI=0.72-0.87), or in Comprehensive Community Cancer Programs (OR=0.33, CI=0.31-0.36), Community Cancer Programs (OR=0.52, CI=0.50-0.54) and Integrated Network Cancer Programs (OR=0.58, CI=0.55-0.61). *Conclusion:* Our study results demonstrate disparities in biopsy type in the treatment of melanoma.

Melanoma is the fifth most common malignancy in the United States (1). Recently published studies have shown that disparities exist in melanoma treatment and outcomes (2-4). However, equality in healthcare delivery to every patient in the US is desired. According to the American Academy of Dermatology guidelines, available in 2001 (5, 6) and to the National Cancer Comprehensive Network Guidelines, available in 1998 (7), excisional biopsy is the standard of treatment and diagnosis for patients that have lesions that raise

suspicion for melanoma. We aimed to analyze the effect that gender, age, race, ethnicity, income, education, insurance, population density, distance from treating facility, facility type, and location have on the type of biopsy used to diagnose patients with cutaneous melanoma.

Patients and Methods

The National Cancer Data Base (NCDB) is a program of the Commission on Cancer of the American College of Surgeons and the American Cancer Society. It is a nationwide database that collects information of approximately 70% of all new cases of cancer and 48.4% of melanoma cases in the United States (7). Integrity checks are run on the submitted data making sure that they are complete and accurate. Otherwise, the cases are returned to the submitting hospital (7). The characteristics and information included in this database allowed us to perform a retrospective cohort study in which we queried the NCDB for patients with melanoma diagnosed between January 1st, 2004 and December 31st, 2015.

Men and women, of all ages, with cutaneous melanoma in situ and malignant melanoma at any stage of the disease were included. Our inclusion criteria included patients who had one of the following biopsy types reported: excisional, punch, shave, or incisional. It is important to note that excisional biopsy is different from wide local excision on the NCDB. Patients who did not have type of biopsy data were excluded. Biopsies other than excisional were merged into 'other' biopsies to facilitate statistical analysis. The variables of interest to our study included patient demographic characteristics: Hispanic origin, race, gender, age, insurance status, income (zip code's population average), education (percentage of people without high school diploma within the zip code of residence), population density of the patient's site of residence, and distance from the zip code of residence to the treating institution. Facility characteristics included facility location and facility type.

We examined the association between biopsy type and demographic and facility type characteristics. The patient characteristics associated with excisional *versus* other types of biopsy were examined using the chi-squared test. Multivariate binary logistic regression was performed to examine how demographic and facility type characteristics influenced the receipt of excisional *versus* other types of biopsy. The

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Key Words: Melanoma, biopsy, socioeconomic factors, disparities.

model used the following covariates: Hispanic origin, race, gender, age, insurance status, income, education population density of the patient's site of residence, distance from the zip code of residence to the treating institution, facility location, and facility type. Patients with missing data were excluded from multivariate regression. Significance levels were set at a p -value of less than 0.05. Statistical analysis was performed using SPSS 25.0 statistical software (IBM, Armonk, NY, USA).

Results

Our cohort included 126,488 patients. Of the 126,488 patients included, 72,053 (57.0%) were men, and the mean age was 61.5 ± 16.13 (SD) years. In terms of race 123,077 (97.3%) were White, 1,402 (1.1%) were other race and 2,009 (1.6%) were missing this information. Melanoma is known to be a disease that predominantly presents in white people. The cohorts of other races were too small for this study so they were all merged into 'other' races. Most patients were insured, 56,247 (44.5%) had private insurance and 65,588 (51.9%) had government insurance. Only 2,408 (1.9%) had no insurance, while 2,245 (1.8%) were missing this information. Table I outlines patient demographics and facility type characteristics by receipt of excisional *versus* other biopsy types. Statistically significant differences were found on all variables on the chi-square test.

As seen in Table II, the results of our multivariate analysis demonstrated that demographic characteristics affected whether patients underwent excisional biopsy or not. Being of Hispanic origin (OR=0.63, CI=0.55-0.71, $p < 0.01$), non-white (OR=0.66, CI=0.58-0.76, $p < 0.01$) or older than 80 years (OR=0.77, CI=0.72-0.81, $p < 0.01$) was found to reduce the likelihood of undergoing excisional biopsy when compared to non-Hispanic, White or patients under 80 years of age. Other characteristics, such as female gender (OR=1.02, CI=0.99-1.1, $p < 0.01$) or income $< \$63,000$ (OR=1.03, CI=0.99-1.074, $p < 0.01$) showed no statistically significant effect. Demographic characteristics that increased the likelihood of undergoing excisional biopsy included residing in a rural (OR=1.12, CI=1.07-1.17, $p < 0.01$) or urban area (OR=1.16, CI=1.04-1.30, $p < 0.01$) when compared to a metropolitan area.

Facility type was also identified as a factor that influenced undergoing excisional biopsy (Table II). Multivariate analysis revealed that patients who received care under Comprehensive Community Cancer Programs (OR=0.33, CI=0.31-0.36, $p < 0.01$), Community Cancer Programs (OR=0.52, CI=0.50-0.54, $p < 0.01$) or Integrated Network Cancer Programs (OR=0.58, CI=0.55-0.61, $p < 0.01$) had reduced odds of undergoing excisional biopsy when compared to Academic/Research Cancer Programs. Facility locations were also associated with statistically significant differences in biopsy type. Using the New England area as reference, we found that patients had higher odds of undergoing excisional biopsy in Middle Atlantic (OR=1.12,

CI=1.05-1.19, $p < 0.01$), East North Central (OR=1.35, CI=1.27-1.45, $p < 0.01$), West North Central (OR=2.40, CI=2.22-2.60, $p < 0.01$), Mountain (OR=1.17, CI=1.081-1.273, $p < 0.01$) and Pacific (OR=3.53, CI=3.29-3.79, $p < 0.01$) areas.

Discussion

Melanoma incidence has been rising for over a decade, making prompt diagnosis and treatment crucial for reducing the mortality of this disease (2, 8). Excisional biopsy is the standard of care for patients with lesions suspicious for melanoma. However, aesthetics might be a significant concern for patients when it comes to the type of biopsy performed. The risk of having a scar or a significant skin defect that might require flap repair is always a possibility with larger biopsies such as excisional biopsy.

Before the year 2000, literature studies reported that partial biopsies that transected the lesion reduced overall survival (9, 10), however, this has not been proven for melanoma (10). Mills and colleagues published a study in 2013 that reported no difference in tumor recurrence or disease-specific survival with biopsy type other than excisional utilizing univariate analysis. The report concluded that shave and punch biopsies, when used appropriately, "should not be discouraged for the diagnosis of melanoma" (11). However, there is also older evidence that states that superficial shave should not be used for pigmented lesions, especially if melanoma is a possible diagnosis (12, 13). A more recent study failed to concur with such findings (14) and supported Mills *et al.* instead. Prospective randomized trials should be performed to solve the dilemma of whether biopsies other than excisional are associated with worse outcomes for patients.

Our study showed that minorities, vulnerable populations such as those over 80 years old, and patients that receive care and non-academic/research institutions have lower odds of undergoing excisional biopsy. Our results are in congruence with several studies (15-17) that have reported disparities in healthcare that commonly affect minorities, patients living in dispersed rural areas or with lower incomes, lower education, or who receive care at non-academic community hospitals. Schrijvers and colleagues reported better survival outcomes for lung, colorectal, breast, prostate, and uterine cancer in patients that resided in more affluent areas when compared to those in more impoverished socioeconomic areas (15). Similarly, in a 2004 meta-analysis, Subramanian and colleagues observed poverty to be a factor for poor overall health and premature mortality from diseases that are considered curable (16), while in 2006, Cormier and colleagues noted low income as a risk factor for poorer outcomes in cancer (17). Comparing our results to these articles shows that disparities are not limited to melanoma and that they occur frequently in other types of cancer.

Table I. Patient characteristics according to biopsy type.

Characteristic	Subgroup	Biopsy type, N (%)		p-Value
		Excisional	Other	
Origin	Non-Hispanic	37,016 (98)	81,133 (99)	<0.01
	Hispanic	709 (2)	983 (1)	
	Total (119,841)	37,725 (100)	82,116 (100)	
Insurance status	Private	18,837 (48)	46,751 (55)	<0.01
	None	1,149 (3)	1259 (1)	
	Government	19,452 (49)	36,795 (43)	
	Total (124,243)	39,438 (100)	84,805 (100)	
Population density	Metropolitan	32,094 (82)	69,772 (84)	<0.01
	Rural	6,190 (16)	11,788 (14)	
	Urban	698 (2)	1,410 (2)	
	Total (121,952)	38,982 (100)	82,970 (100)	
Distance from facility	1-200 miles	39,350 (98)	83,774 (98)	<0.01
	201-500 miles	387 (1)	1,027 (1)	
	501-1,000 miles	181 (0)	337 (0)	
	>1,000 miles	149 (0)	404 (1)	
	Total (125,609)	40,067 (100)	85,542 (100)	
Race	White	39,143 (99)	83,934 (99)	<0.01
	Other	600 (1)	802 (1)	
	Total (124,479)	39,743 (100)	84,736 (100)	
Age group	<40 Years	3,826 (9)	8,716 (10)	<0.01
	40-60 Years	12,595 (31)	28,888 (34)	
	61-80 Years	17,696 (44)	38,491 (45)	
	>80 Years	6,371 (16)	9,905 (12)	
	Total (126,488)	40,488 (100)	86,000 (100)	
Facility location	New England	2,687 (7)	4,843 (6)	<0.01
	Middle Atlantic	6,487 (18)	12,552 (16)	
	South Atlantic	9,667 (26)	12,127 (16)	
	East North Central	5,668 (15)	11,637 (15)	
	East South Central	1,909 (5)	2,140 (3)	
	West North Central	2,523 (7)	9,490 (12)	
	West South Central	1,847 (5)	2,164 (3)	
	Mountain	2,207 (6)	4,263 (6)	
	Pacific	3,667 (10)	18,068 (23)	
	Total (113,946)	36,662	77,284	
Facility type	Academic/research	15,285 (42)	43,463 (56)	<0.01
	Comprehensive Community	3,486 (10)	3,101 (4)	
	Community	14,309 (39)	25,969 (34)	
	Integrated Network	3,582 (10)	4,751 (6)	
	Total (113,946)	36,662	77,284	
Gender	Male	23,367 (58)	48,686 (57)	<0.01
	Female	17,121 (42)	37,314 (43)	
	Total (126,488)	40,488	86,000	
Average income	≥\$63,000	15,150 (38)	38,612 (45)	<0.01
	<\$63,000	24,921 (62)	46,888 (55)	
	Total (125,571)	40,071	85,500	
Education*	<7%	12,499 (31)	33,958 (40)	<0.01
	7-12.9%	14,454 (36)	30,147 (35)	
	13-20.9%	9,117 (23)	15,342 (18)	
	>21%	4,027 (10)	6,088 (7)	
	Total (125,632)	40,097	85,535	

Community: Community Cancer Program. *Percentage with high-school diploma.

Table II. Odds ratio of undergoing excisional biopsy of melanoma.

Characteristic	OR (95% CI)	p-Value
Origin		
Non-Hispanic	1	
Hispanic	0.627 (0.553-0.711)	<0.01
Insurance status		
Private	1	
None	0.529 (0.475-0.588)	<0.01
Government	0.923 (0.888-0.960)	<0.01
Population density		
Metropolitan	1	
Rural	1.121(1.072-1.171)	<0.01
Urban	1.163 (1.04-1.302)	<0.01
Distance from facility		
1-200 miles	1	
201-500 miles	0.853 (0.735-0.990)	0.036
501-1,000 miles	0.667 (0.532-0.837)	<0.01
>1,000 miles	1.077 (0.854-1.359)	0.529
Race		
White	1	
Other	0.662 (0.575-0.761)	<0.01
Age group		
40-60 Years	1	
61-80 Years	1.012 (0.972-1.053)	0.574
>80 Years	0.765 (0.724-0.808)	<0.01
Facility location		
New England	1	
Middle Atlantic	1.118 (1.046-1.194)	<0.01
South Atlantic	0.778 (0.729-0.831)	<0.01
East North Central	1.358 (1.268-1.453)	<0.01
East South Central	0.917 (0.836-1.006)	0.068
West North Central	2.403 (2.224-2.596)	<0.01
West South Central	1.013 (0.922-1.113)	0.783
Mountain	1.173 (1.081-1.273)	<0.01
Pacific	3.534 (3.291-3.794)	<0.01
Facility type		
Academic/Research	1	
Comprehensive Community	0.333 (0.313-0.355)	<0.01
Community	0.517 (0.500-0.535)	<0.01
Integrated Network	0.579 (0.548-0.612)	<0.01
Gender		
Male	1	
Female	1.019 (0.988-1.050)	0.233
Income		
≥\$63,000	1	
<\$63,000	1.033 (0.994-1.074)	0.101
Education*		
<7%		
7-12.9%	0.841(0.808-0.875)	<0.01
13-20.9%	0.764 (0.727-0.803)	<0.01
>21%	0.721(0.676-0.769)	<0.01

CI: Confidence interval; OR: odds ratio; Community: Community Cancer Program. *Percentage with high-school diploma.

Unfortunately, as in most fields of medicine, disparities affecting patients with lower income and lower education, minorities, and those without insurance have been reported in melanoma treatment and outcomes (2-4). Our study showed

that these disparities are also present in regard to the type of biopsy that patients undergo. For example, when adjusted for confounders, Hispanic origin, government insurance or no insurance, non-White race and living in a zip code with a higher percentage of people without a high school diploma reduces the likelihood of an excisional biopsy.

Our study is not without limitations. The NCDB is a database that records approximately 70% of patients newly diagnosed with cancer in the US, but its fidelity is subject to every institution's compliance with accurately reporting all generated information. Furthermore, the NCDB has only one section for reporting the procedure performed on each patient. As a result, most patients did not have biopsy procedures reported, causing us to exclude a large number of patients from our study. Moreover, melanoma is a disease that affects primarily White people, making the cohort of other races substantially smaller. Another limitation of our study is that patients reported with excisional biopsy may have undergone a different type of biopsy initially followed by excisional biopsy based on the initial biopsy report.

This is, to our knowledge, the first study that evaluated disparities in the type of biopsy that patients with melanoma undergo. From the results, we learned that efforts need to be made to increase compliance with guidelines and further studies are needed to identify causality of disparities in the initial approach to melanoma.

Conflicts of Interest

All Authors report no conflicts of interest in regard to this study.

Authors' Contributions

All Authors contributed to the study design, commented on previous versions of the article, read and approved the final article. Material preparation, data collection and analysis were performed by DJR, ACS and AJF. The first draft of the article was written by DJR and MTH.

Acknowledgements

This study was supported in part by the Mayo Clinic Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery and Center for Individualized Medicine.

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Received September 2, 2019
Revised September 18, 2019
Accepted September 19, 2019