SKIN

ORIGINAL RESEARCH

Understanding the Factors Associated with US Dermatology Resident Trainees' Diagnostic Confidence and Skill for Skin of Color Pathology

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ABSTRACT

Background: Inequities in dermatologic health outcomes translate to worsened clinical outcomes for minority groups. For example, despite a lower incidence of skin cancer overall, African Americans are diagnosed at later stages with greater degrees of lymph node involvement. This has been shown to lead to disproportionate mortality when compared to lighter skinned individuals. Medical education materials contain a significantly lower percentage of skin of color (SOC) images than of lighter skin and research has indicated lower diagnostic accuracy of dermatologic conditions in darker skin by U.S. medical students. The objective of this study was to explore U.S. resident dermatologists' ability to accurately identify skin pathology among SOC patients versus lighter skin to potentially identify gaps in training that may contribute to this disproportionate morbidity and mortality.
Methods: A cross-sectional electronic REDCap survey open to all U.S. dermatology residents asked participants their basic demographics (e.g., level of training, racial and ethnic identity) and program characteristics (e.g., geographical location, proportion of patients by Fitzpatrick type, presence of a dedicated SOC clinic). This data was correlated with participant visual diagnostic accuracy on a 22-item multiple choice quiz (images selected by a senior academic dermatologist) of characteristic nonmalignant and malignant conditions in lighter skin and SOC.
Results: Residents preferentially misdiagnosed malignant lesions in SOC over lighter skin ($p < .0001$) and preferentially misdiagnosed malignant lesions in SOC over nonmalignant lesions in SOC ($p < .001$). None of the residents' basic demographic or program characteristic variables had significant relationships with any assessment of performance.
Conclusion: Dermatologists should maintain a high clinical suspicion for malignant conditions in patients with darker skin types, given that these lesions are the most preferentially misdiagnosed and the fact that these lesions carry higher risks for morbidity and mortality. Dermatology residency programs should instill efforts to emphasize correct detection of malignant lesions amongst those with skin of color.

INTRODUCTION

Inequities in dermatologic health outcomes exist at every level of care delivery including disease prevention, screening, diagnosis, and treatment.[1] This translates to worsened clinical outcomes for minority groups. For example, despite a relatively lower incidence of skin cancer overall, Black patients with

skin cancer are diagnosed at later stages and have a greater degree of lymph node involvement.[2] Differential (higher) mortality among Black patients has been reported as a result.[1]

The structural causes of these health disparities are multifaceted. Identified contributing factors include cultural perception about "immunity" to various dermatologic conditions including skin cancer, socioeconomic barriers to specialty care in general, and the atypical presentation of malignant lesions amongst minority groups.[2] One important factor in mitigation of these disparities is accurate diagnosis by a Dermatologist. Empiric assessments of medical education materials have demonstrated a significantly lower percentage of darker, skin of color images as compared to lighter skin.[3] In tandem, medical students' have lower diagnostic accuracy for dermatologic conditions in darker skin types versus lighter ones.[4] While studies have shown that U.S. dermatology residents exposed to more skin of color pathology in their training are more confident in their diagnostic abilities, the impact of such increased exposure on actual diagnostic accuracy has not yet been rigorously assessed.[5] The objective of this study was to explore resident dermatologists' ability to identify skin pathology among patients with skin of color in order to examine gaps in training that may exist and subsequently contribute to the disproportionate morbidity and mortality for darker-skinned patients with skin cancer.

METHODS

A cross-sectional REDCap-administered survey was distributed to all residency programs in the United States via the Association of Program Directors in Dermatology email listserv in August 2022. The survey was open for two months, during which two reminder emails were sent. Anonymous participation was requested from all interested dermatology resident physicians in a US-based ACGME-accredited program. Participants were asked about their own demographics (including gender, racial and ethnic identity, and training level) as well as basic information about their own program (including geographical location, estimated proportion of patients according to Fitzpatrick skin type, and presence of a dedicated skin of color clinic). United States regions were classified as: Northeast (Maine, Vermont, New Hampshire, New York, Massachusetts, Connecticut, Rhode Island, Pennsylvania, New Jersey, Maryland, and Delaware); Southeast (Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, Tennessee, Kentucky, West Virginia, Virginia, North Carolina, and South Carolina); Midwest (North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Michigan, Illinois, Indiana, and Ohio); Southwest (Texas, Oklahoma, New Mexico, and Arizona); and West (Washington, Oregon, California, Idaho, Nevada, Utah, Montana, Wyoming, and Colorado).

All questions were optional. A 22-item multiple choice quiz was also included with images of clinical pathology (non-malignant and malignant) among patients with varying skin colors. A board-certified academic dermatologist with over 20 years of clinical experience evaluated all images for appropriate representation of the given condition and provided a differential diagnosis list (these alternative conditions were used as incorrect answer choices in the quiz). Images were then sorted into "light" (predominately Caucasian, corresponding to Fitzpatrick types I-III) and "dark" (skin of color patients, Fitzpatrick types IV-VI). Images of

non-malignant conditions included Acne Vulgaris, Psoriasis, Verruca Vulgaris, Allergic Contact Dermatitis, Atopic Dermatitis, Herpes Zoster, and Impetigo. Images of malignant lesions included Basal Cell Carcinoma, Squamous Cell Carcinoma In Situ, Cutaneous Squamous Cell Carcinoma, and Melanoma.

Quiz responses and accuracy were calculated overall as well as sub-scores for accuracy among light vs dark skin tones overall, light malignant lesions vs. dark malignant lesions, and dark non-malignant lesions vs dark malignant lesions. This primary outcome variable, diagnostic accuracy scores (continuous variable), was assessed across respondent demographic variables and program characteristics using SAS statistical software version 9.4. Prior to dissemination, this study was reviewed and approved by the Institutional Review Board and the Association of Program Directors in Dermatology board. Explicit permission for image use was sought and granted from the following partner organizations: VisualDx, DermNet New Zealand, and SkinDeep. These organizations retain all copyrights to their images.

RESULTS

A total of 36 individuals completed the survey. Among these approximately half were female (53%, n=18), the majority identified their race as white (71%, n=25) and their ethnicity as not Hispanic or Latino (89%, n=32). Nearly all respondents reported working in an urban setting (97%, n=35). Respondents reported coming from a total of 16 different states representing all five regions of the United States. Respondents skewed towards earlier in their training, with most being PGY2 level (42%, n=15), followed by PGY3 (33%, n=12), and the least number of respondents being PGY4 (25%, n=9). See **Table 1**. Half of respondents reported having no dedicated skin of color clinic (50%, n=18), and three respondents (8.3%) were not sure. There was no statistically significant difference in the proportion of patients with darker skin types (Fitzpatrick IV-VI) among respondents with or without a dedicated skin of color clinic (p=0.82).

We first assessed overall performance on the assessment tool and found no significant difference between performance across skin types (84.7% correctly diagnosed overall; 85.4% for conditions in light skin types; 84.3% in darker skin types; p>0.05). We then analysed respondent score performance on diagnosis of cancerous conditions for images of patients with lighter versus darker skin types and found a significant difference (100% for conditions in lighter skin types; 75% in darker skin types; p<0.0001). Lastly, we assessed score performance when diagnosing malignant versus non-malignant lesions in patients with darker skin types and found that survey respondents performed significantly worse in diagnosing malignant lesions (75% for malignant lesions versus 91.3% for non-malignant lesions; p<0.0001). All of these analyses were assessed with regard to respondent demographic information, without any of these factors being statistically significant (gender, racial and ethnic identity, level of training, geographical location, presence of a dedicated skin of color clinic, and estimated proportion of patients with darker Fitzpatrick skin types; all p>0.05). See **Table 2.**

DISCUSSION

Among resident physician trainees, there is a gap in identification of skin cancer pathology among patients with darker skin types, in the context of an otherwise comparable

Table 1. Demographic information about respondents according to training year level.

	All % (n)	PGY2	PGY3	PGY4	P value
[1]**Gender**					
Female	53.0% (18)	64.3% (9)	33.3% (4)	62.5% (5)	0.24
Male	47.0% (16)	35.7% (5)	66.7% (8)	37.5% (3)	
[2]**Race**					
Asian	14.3% (5)	14.3% (2)	16.7% (2)	11.1% (1)	0.69
Black	8.6% (3)	14.3% (2)	8.3% (1)	0	
White	71.4% (25)	57.1% (8)	75.0% (9)	88.9% (8)	
Other	5.7% (2)	14.3% (2)	0	0	
[2]**Ethnicity**					
Hispanic/Latino	8.6% (3)	7.1% (1)	8.3% (1)	11.1% (1)	0.99
Not Hispanic/Latino	91.4% (3)	92.9% (13)	91.7% (11)	88.9% (8)	
[2]**US Region**					
Northeast	19.4% (7)	33.3% (5)	8.3% (1)	11.1% (1)	0.11
Southeast	13.9% (5)	6.7% (1)	25.0% (3)	11.1% (1)	
Midwest	44.4% (16)	20.0% (3)	58.3% (7)	66.7% (6)	
Southwest	16.7% (6)	33.3% (5)	0	11.1% (1)	
West	5.6% (2)	6.7% (1)	8.3% (1)	0	
[2]**Setting**					
Rural	2.8% (1)	0	0	11.1% (1)	0.25
Urban	97.2% (36)	100% (15)	100% (12)	88.9% (8)	
***Quiz Score Overall** Mean, SD	84.3%, 6.1%	85.2%, 5.0%	83.7%, 4.9%	85.4%, 6.3%	0.72
Quiz Sub-score, Lighter Skin Mean, SD	85.4%, 11.4%	87.5%, 10.6%	85.4%, 9.0%	81.9%, 15.5%	0.53
Quiz Sub-score, Darker Skin Mean, SD	84.3%, 6.1%	83.8%, 5.7%	82.7%, 4.8%	87.3%, 7.8%	0.22

Note: PGY: Post Graduate Year [of training]. Not all respondents provided answers to all questions.
[1]Chi Square
[2]Fisher's Exact Test
*Data shown are Mean Score Percentage, Standard Deviation. ANOVA was used to assess differences in scores

Table 2. Comparison of diagnostic accuracy.

	Lighter skin	Darker skin	T – test comparison	Comparison to measured variables
1st analysis: Overall scores	85.4%	84.3%	No significant difference	No significant relationship
2nd analysis: Scores on malignant lesions	100%	75%	Statistically significant difference (p <.0001)	No significant relationship
	Non-malignant	**Malignant**	**T – test comparison**	**Comparison to measured variables**
3rd analysis: Scores on malignant lesions vs. non-malignant lesions in skin of color	91.3%	75%	Statistically significant difference (p <.001)	No significant relationship

diagnostic accuracy for benign skin conditions. Our findings fit with recent trends in dermatology graduate medical education that have focused on advancing physician knowledge of common cutaneous conditions that affect patients with darker skin types. Skin cancer in contrast, is less common in patients with darker skin types, and thus may not be the target for curricular interventions at this time. Our results are congruent with a 2022 study which identified that dermatology residents are more likely to biopsy non-malignant lesions than malignant lesions of darker skin.[10] While the national push for improved recognition and treatment for cutaneous diseases in darker skin types has improved for the average patient, such efforts may not yet translate into improved health equity nor health outcomes with regard to skin cancer. It thus remains of concern that some lesions may be misdiagnosed or delayed in diagnosis, yielding higher risk for morbidity and mortality.

The Social Ecological Model, one of the most widely used public health models, depicts health as a by-product of influential factors at the individual, interpersonal, institutional, and community levels.[8] In this study, we attempted to understand the interpersonal level as a source of health disparities: the ability of dermatology physicians to diagnose conditions in patients with darker versus lighter skin tones. In our study, we did not find a statistically significant difference amongst comparison of quiz performance to any of the measured variables rules out the hypothesis that they may predict the resident's visual diagnostic accuracy, notably including respondent demographic factors, presence

at a program with a dedicated skin of color clinic, or higher estimated proportion of patients with darker skin types. Given that dermatology residents are generally well-equipped to accurately identify lesions regardless of skin type, other sources of this disparity must be considered. Solutions to factors at the institutional and community levels, such as barriers to health insurance registration, barriers to traveling to medical appointments, and individual level barriers, such as individual health literacy, must be equally explored as potential intervention targets. While more work is yet to be done to enhance the therapeutic bond and fully optimize interpersonal interactions between patients and their physicians, healthcare professionals must not neglect the broader societal factors implicated in the development of health disparities in dermatology.

Strengths and Limitations

Despite being open to all residents in ACGME-accredited dermatology residency programs, our sample size was low in this exploratory study. This may have been due in part to survey dissemination to program administrators rather than directly to residents; some programs may have policies in place against survey participation solicitation from outside sources such as our study. The survey was also disseminated during the beginning of the medical academic year, which may have resulted in it being de-prioritized due to the residents' changing responsibilities and rotations in the summer months. However, with our sample size we remained powered to detect large effect size, statistically significant differences (beta = 0.2, alpha = 0.05).[11] While larger studies with alternative recruitment strategies remain needed, our study points to an alarming difference in diagnostic accuracy for malignant lesions in darker versus lighter skin types. Given the known disparities in skin cancer survival for patients with darker versus lighter skin types, our study demonstrates that residency programs must emphasize identification of such lesions as part of our nation's overall efforts to improve skin cancer survival for individuals from all communities.

CONCLUSION

The U.S Census Bureau projects that by 2050, over 50% of the U.S population will be a person of color (African American, Hispanic, and Asian Americans).[9] It is imperative now more than ever that efforts are being made to ensure the field of dermatology remains accessible and to mitigate the risk of widening of known health disparities among an increasingly diverse patient population. Dermatologists should maintain a high clinical suspicion for malignant conditions in patients with darker skin types, given that these lesions are the most preferentially misdiagnosed and the fact that these lesions carry higher risks for morbidity and mortality. We commend the national efforts to advance health equity in the field of dermatology via curricular changes, and further recommend additional efforts to highlight cutaneous malignancies as a featured topic within such changes.

Acknowledgements: Special permission for the use of these images and specific, explicit approval for the images included in this study has been granted by each of the partner organizations from which the images were taken, including VisualDx, DermNet New Zealand, and SkinDeep. We would like to thank all of these collaborators for their support.

Conflict of Interest Disclosures: None

Funding: None

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