

Journal Pre-proof

Representation of dark skin images of common dermatologic conditions in educational resources: a cross-sectional analysis

Savannah M. Alvarado, BA, Hao Feng, MD, MHS



PII: S0190-9622(20)31138-5

DOI: <https://doi.org/10.1016/j.jaad.2020.06.041>

Reference: YMJD 14828

To appear in: *Journal of the American Academy of Dermatology*

Received Date: 14 April 2020

Revised Date: 5 June 2020

Accepted Date: 10 June 2020

Please cite this article as: Alvarado SM, Feng H, Representation of dark skin images of common dermatologic conditions in educational resources: a cross-sectional analysis, *Journal of the American Academy of Dermatology* (2020), doi: <https://doi.org/10.1016/j.jaad.2020.06.041>.

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2020 Published by Elsevier on behalf of the American Academy of Dermatology, Inc.

1 **Article type:** Research Letter

2 **Representation of dark skin images of common dermatologic conditions in educational**
3 **resources: a cross-sectional analysis**

4 Savannah M. Alvarado, BA^a, Hao Feng, MD, MHS^b

5 ^aUniversity of Connecticut School of Medicine, Farmington, CT; ^bDepartment of Dermatology,
6 University of Connecticut Health Center, Farmington, CT

7

8 **Corresponding Author:**

9 Hao Feng, MD, MHS

10 Department of Dermatology

11 University of Connecticut Health Center

12 21 South Rd, 2nd Floor

13 Farmington, CT 06032

14 Phone: 860-679-7546

15 Fax: 860-679-7534

16 Email: haofeng625@gmail.com

17

18 **Funding Sources:** None

19

20 **Conflicts of Interest:** None declared.

21

22 **IRB Approval Status:** This study did not qualify as human subject research; therefore,
23 institutional review board approval was not required at the University of Connecticut Health
24 Center.

25

26 **Reprint Requests:** Hao Feng, MD, MHS

27

28 **Manuscript Word Count:** 497

29 **References:** 5

30 **Figures:** 0

31 **Tables:** 2

32

33 **Keywords:** diversity, skin tone, educational materials, textbook, dermatology

34 Cutaneous pathology appears significantly different on disparate skin tones. Access to
35 educational materials demonstrating pathology across all skin tones plays a crucial role in
36 developing pattern recognition skills and improving diagnostic confidence.^{1,2} Given the
37 increasingly diverse patient population and known dermatologic health disparities³ we aimed to
38 assess the prevalence of dark skin images in widely used, contemporary print and web-based
39 dermatology resources.

40 Eight commonly used resources (six textbooks and two web-based) and 65 conditions
41 were selected for review. For each condition, images were categorized as light skin images, dark
42 skin images (DSI: Fitzpatrick V-VI), or indeterminate (due to extent of disease involvement,
43 image frame, or lighting).

44 Of the 15,445 images across all resources, 19.5% were DSI. Online resources had a
45 greater representation of DSI (22.1%) compared to printed texts (10.3%) (**Table I**). For online
46 resources, VisualDx had a greater representation of DSI (28.5%) compared to DermNet NZ
47 (2.8%). DSI representation varied based on dermatologic conditions. Disorders of Langerhans
48 cells and macrophages had the greatest representation of DSI (36.8%) whereas neoplasms of the
49 skin (10.6%) and adnexal diseases (12.3%) had the lowest (**Table II**). These discrepancies are
50 not consistently reflective of incidence and prevalence in the population; overall there is
51 disproportionately lower representation when comparing the proportion of DSI to
52 epidemiological data. However, the high representation of DSI in conditions such as sarcoidosis
53 and syphilis may be reflective of a disproportionate incidence in dark skinned individuals.

54 This analysis underscores variations in DSI representation among learning resources and
55 dermatologic conditions. The lower representation of DSI in textbooks may relate to the limited
56 space, need to demonstrate classic cases, and reuse of images. Online resources have more

57 flexibility to add images to their database, allowing for a more comprehensive illustration of
58 pathology. Accordingly, VisualDx demonstrates pathology on dark skin in remarkably high
59 proportion compared to other resources.

60 Our data demonstrates an exceedingly low representation of DSI in neoplasms of the
61 skin, which is consistent with prior studies.⁴ Although the incidence of most skin cancers is
62 lower in individuals with dark skin, these patients often suffer worse clinical outcomes including
63 disproportionately higher morbidity and mortality.^{3,5} Consequently, rather than reflecting the
64 incidence of disease in the patient population, educational materials must comprehensively
65 illustrate all pathology in patients of a spectrum skin tones. This includes presentations that
66 trainees may be unlikely to encounter through the course of their clinical training. Images should
67 be supplemented with clinical pearls for conditions harder to diagnose in darker skin tones
68 although this should not replace high quality photographs.

69 This study is limited by the inherent subjective nature of designating skin tone, omission
70 of minorities with lighter skin tone, and the inability to directly link DSI representation and
71 patient outcomes. Increased effort and guidance pertaining specifically to photographing skin of
72 color are needed given the challenges of photographing pathology on dark skin. With the gap in
73 availability of DSI in dermatology educational materials, online resources may play a role in
74 providing more exposure to pathology on dark skin.

75 **REFERENCES**

- 76 1. Rimoin L, Altieri L, Craft N, Krasne S, Kellman PJ. Training pattern recognition of skin
77 lesion morphology, configuration, and distribution. *Journal of the American Academy of*
78 *Dermatology*. 2015;72(3):489-495. doi:10.1016/j.jaad.2014.11.016
- 79 2. Fourniquet E, Garvie K, Beiter K. Exposure to Dermatological Pathology on Skin of Color
80 Increases Physician and Student Confidence in Diagnosing Pathology in Patients of Color.
81 *The FASEB Journal*. 2019;33.
- 82 3. Buster KJ, Stevens EI, Elmets CA. Dermatologic Health Disparities. *Dermatologic Clinics*.
83 2012;30(1):53-59. doi:10.1016/j.det.2011.08.002.
- 84 4. Louie P, Wilkes R. Representations of race and skin tone in medical textbook imagery.
85 *Social Science & Medicine*. 2018;202:38-42. doi:10.1016/j.socscimed.2018.02.023
- 86 5. Davis SA, Narahari S, Feldman SR, Huang W, Pichardo-Geisinger RO, McMichael AJ. Top
87 dermatologic conditions in patients of color: an analysis of nationally representative data. *J*
88 *Drugs Dermatol*. 2012;11(4):466- 473.

89 **TABLES**

90 Table I: Extent of illustration of dark skin in commonly used dermatologic learning resources for
 91 the 65 common dermatologic conditions included in this study.

Learning Resources	Total	Light	Dark	Indeterminate	Dark (%)
Printed texts	3469	3067	356	46	10.3
Dermatology, 4e <i>Bolognia</i>	748	634	99	15	13.2
Andrews' Diseases of the Skin, 13e <i>James</i>	372	295	74	3	19.9
Fitzpatrick's dermatology, 9e <i>Kang</i>	516	428	78	10	15.1
Rook's textbook of dermatology, 8e <i>Rook</i>	544	493	40	11	7.4
Clinical dermatology: a color guide to diagnosis and therapy, 6e <i>Habif</i>	863	822	39	2	4.5
Fitzpatrick's color atlas and synopsis of clinical dermatology, 6e <i>Wolff</i>	426	395	26	5	6.1
Online resources	11976	9269	2652	55	22.1
VisualDx	9007	6417	2569	21	28.5
DermNet NZ	2969	2852	83	34	2.8
Total	15445	12336	3008	101	19.5

92

93 Table II: Extent of illustration of dark skin in common dermatologic conditions across all
 94 dermatologic learning resources (printed texts and online resources) and available incidence and
 95 prevalence epidemiologic data for these dermatologic conditions.

Dermatologic Conditions and Diagnoses	Number of Total Images	Number of Dark Skin Images	Percentage of Dark Skin Images	Disease Incidence/Prevalence for General Population	Disease Incidence/Prevalence by Race/Ethnicity
<i>Disorders of Langerhans Cells and Macrophages</i>	473	174	36.8		
Sarcoidosis	201	116	57.7	7.6-8.8 per 100,000 incidence (general population)	17.8-46 per 100,000 incidence (African American)
Xanthoma	195	52	26.7	1-4% prevalence (general population)	<i>No reliable figures available</i>
Necrobiosis lipoidica	77	6	7.8	0.3-1.2% prevalence (general population with diabetes)	<i>No reliable figures available</i>
<i>Infections, Infestations, and Bites</i>	4095	1010	24.7		
Syphilis	436	259	59.4	3-18.7 per 100,000 incidence (general population)	8.4-28.1 per 100,000 incidence (African American)
Pityriasis versicolor	166	55	33.1	1.1% prevalence (general population in Sweden)	<i>No determined difference based on ethnicity</i>
Tinea	526	153	29.1	21.3 per 100,000 prevalence (general population)	17.8 per 100,000 prevalence (African American)
Varicella	198	56	28.3	4.1 per 100,000 incidence (general population)	7.8 per 100,000 incidence (African American)
Herpes zoster	261	70	26.8	12.4% prevalence (general population aged 60+ years)	8% prevalence (African American)
Molluscum	222	53	23.9	<5% prevalence (general pediatric population); 33% prevalence (patients with HIV)	2-4 odds ratio of prevalence (not white compared to white)
Impetigo	242	57	23.6	1,080-2,220 per 100,000 incidence (general pediatric)	<i>No reliable figures available</i>

				population)	
Warts	404	95	23.5	37.3% incidence (general male population)	45.7% incidence (African American males)
Scabies	310	62	20	221-281 per 100,000 prevalence (general population)	<i>No determined difference based on ethnicity</i>
Insect bite	167	26	15.6	<i>No reliable figures available</i>	<i>No determined difference based on ethnicity</i>
Measles	111	16	14.4	0.02-0.04 per 100,000 incidence (general population)	0.04 per 100,000 incidence (minority populations)
Candidiasis	246	35	14.2	<i>No reliable figures available</i>	<i>No determined difference based on ethnicity</i>
Herpes simplex	362	50	13.8	47.8% prevalence (HSV1); 11.9% prevalence (HSV2) (general population)	58.5% prevalence (HSV1); 34.6% prevalence (HSV2) (African American)
Cellulitis	113	15	13.3	200.3 per 100,000 incidence (general population)	200.6 per 100,000 incidence (African American)
Erysipelas	77	5	6.5	249 per 100,000 incidence (general population)	<i>No determined difference based on ethnicity</i>
Erythema infectiosum	55	1	1.8	90% prevalence of seropositivity (general population aged 60+ years)	<i>No determined difference based on ethnicity</i>
Erythema migrans	122	2	1.6	27.0 per 100,000 incidence (general population)	4.8 per 100,000 incidence (African American)
Rubella	46	0	0	<0.01 per 100,000 incidence (general population)	9% of cases were in African American patients
Roseola	31	0	0	77% prevalence of seropositivity (general population aged 24 months)	<i>No determined difference based on ethnicity</i>
<i>Rheumatologic and Systemic Dermatologic Diseases</i>	1996	488	24.4		

Vitiligo	288	109	37.8	0.2 per 100,000 prevalence (general population)	<i>No reliable figures available</i>
Scleroderma/morphea	319	101	31.7	24.2 per 100,000 prevalence (general population)	31.5 per 100,000 prevalence (African American)
Alopecia	176	53	30.1	2.1% lifetime incidence (general population)	1.77 odds ratio of incidence (African American compared to White)
Cutaneous lupus erythematosus	450	114	25.3	4.2 per 100,000 incidence (general population)	119 per 100,000 incidence (African American)
Systemic lupus erythematosus	220	47	21.4	2.9 per 100,000 incidence (general population)	7.2 per 100,000 incidence (African American)
Granuloma annulare	221	43	19.5	0.1-0.4% prevalence (general population seeking dermatology consultations)	<i>No determined difference based on ethnicity</i>
Lichen sclerosis et atrophicus	232	19	8.2	100-330 per 100,000 incidence (general population of US Armed Forces)	1.4 per 100,000 prevalence (African American dermatology consultations)
Erythema nodosum	90	2	2.2	0.38-0.5% prevalence (general population)	<i>No reliable figures available</i>
<i>Papulosquamous and Eczematous Dermatoses</i>	2845	596	20.9		
Lichen simplex chronicus	100	48	48	4.04-12% prevalence (general population)	<i>No determined difference based on ethnicity</i>
Pityriasis rosea	189	81	42.9	172.2 per 100,000 incidence (general population)	2 odds ratio of incidence (African Americans compared to the rest of the population)
Erythroderma	141	46	32.6	0.9-2 per 100,000 prevalence (general population)	<i>No reliable figures available</i>
Ichthyosis	220	60	27.3	0.5 per 100,000 prevalence (general population)	<i>No reliable figures available</i>

Seborrheic dermatitis	139	37	26.6	1-11.6% prevalence (general population)	0.36-0.39 odds ratio of prevalence (light brown and black skin compared to white)
Lichen planus	359	85	23.7	1.27% prevalence (general population)	<i>No reliable figures available</i>
Psoriasis	518	99	19.1	3.2% prevalence (general adult population)	1.9% prevalence (African American)
Stasis dermatitis	131	20	15.3	6-7% prevalence (general population aged 50+ years)	<i>No determined difference based on ethnicity</i>
Atopic dermatitis	151	20	13.2	0.2-24.6% prevalence (general population)	1.7 odds ratio of prevalence (African American compared to European American)
Erythema annulare centrifugum	111	13	11.7	1 per 100,000 incidence (general population)	<i>No reliable figures available</i>
Contact dermatitis	756	85	11.2	20% prevalence (general population)	<i>No determined difference based on ethnicity</i>
Cheilitis	37	2	5.4	0.7% prevalence (general population)	17% incidence (individuals with dark skin tones)
<i>Urticarias, Erythemas, Purpuras, and Vascular Disorders</i>	1218	192	15.8		
Erythema multiforme	262	63	24	0.01-1% incidence (general population)	<i>No reliable figures available</i>
Drug eruptions	422	66	15.6	180-700 per 100,000 prevalence (general population of hospitalized patients)	<i>No reliable figures available</i>
Vasculitis	211	31	14.7	200 per 100,000 incidence (general population)	<i>No reliable figures available</i>
Infantile hemangioma	167	17	10.2	4.5% incidence (general population)	3.5% incidence (African American)
Urticaria	156	15	9.6	0.23% prevalence (general population)	0.29% prevalence (African American)
<i>Vesicobullous Diseases</i>	369	56	15.2		

Bullous pemphigoid	153	30	19.6	12 per 100,000 prevalence (general population)	15.4 per 100,000 prevalence (African Americans)
Dermatitis herpetiformis	74	12	16.2	10-11.2 per 100,000 prevalence (general population)	<i>No reliable figures available</i>
Pemphigus vulgaris	142	14	9.9	0.42-0.68 per 100,000 prevalence (general population)	<i>No reliable figures available</i>
<i>Adnexal Diseases</i>	1180	145	12.3		
Keratosis pilaris	95	24	25.3	40-80% prevalence (general population)	<i>No determined difference based on ethnicity</i>
Miliaria	115	26	22.6	30% incidence (general population)	<i>No reliable figures available</i>
Acne vulgaris	569	64	11.2	14.3-24% prevalence (general population)	37% prevalence (African American women)
Folliculitis	220	21	9.5	<i>No reliable figures available</i>	<i>No reliable figures available</i>
Rosacea	181	10	5.5	5.496% prevalence (general population of dermatology patients)	10% prevalence (skin of color)
<i>Neoplasms of the skin</i>	3269	347	10.6		
Neurofibroma	119	48	40.3	33.3 per 100,000 prevalence (general population)	<i>No determined difference based on ethnicity</i>
Cutaneous T cell lymphoma	300	108	36	1.07 per 100,000 incidence (general population)	1.15 per 100,000 incidence (African American)
Kaposi sarcoma	201	47	23.4	0.6 per 100,000 incidence (general population)	2.96 per 100,000 incidence (African American)
Seborrheic keratosis	203	20	9.9	90% prevalence (general population aged 60+ years)	<i>No reliable figures available</i>
Squamous cell carcinoma/ keratoacanthoma	363	32	8.8	296-497 per 100,000 incidence (general population)	3 per 100,000 incidence (African American)
Benign melanocytic nevus	791	58	7.3	95% prevalence (general population)	0.12 odds ratio of incidence (Fitzpatrick V versus I and II)
Dermatofibroma	17	1	5.9	<i>No reliable figures available</i>	<i>No reliable figures available</i>

Melanoma	620	24	3.9	22 per 100,000 incidence (general population)	0.9 per 100,000 incidence (African American)
Basal cell carcinoma	381	9	2.4	226-353 per 100,000 incidence (general population)	0.06 odds ratio of prevalence (African American compared to White)
Actinic keratosis	274	0	0	11-26% incidence (general population)	<i>No reliable figures available</i>
Total	15445	3008	20.1		

96

97

98

Journal Pre-proof