REVIEW

Integrating skin color assessments into clinical practice and research: A review of current approaches

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Skin color classification can have importance in skin health, pigmentary disorders, and oncologic condition assessments. It is also critical for evaluating disease course and response to a variety of therapeutic interventions and aids in accurate classification of participants in clinical research studies. A panel of dermatologists conducted a literature review to assess the strengths and limitations of existing classification scales, as well as to compare their preferences and utilities. We identified 17 skin classification systems utilized in dermatologic settings. These systems include a range of parameters such as UV light reactivity, race, ethnicity, and degree of pigmentation. The Fitzpatrick skin type classification is most widely used and validated. However it has numerous limitations including its conflation with race, ethnicity, and skin color. There is a lack of validation data available for the remaining scales. There are significant deficiencies in current skin classification instruments. Consensus-based initiatives to drive the development of validated and reliable tools are critically needed. (J Am Acad Dermatol https://doi.org/10.1016/j.jaad.2024.01.067.)

Key words: classification; ethnicity; pigmentation; skin color; skin tone scales; skin type.

INTRODUCTION

Skin color

Human skin occurs in a kaleidoscope of colors, with different shades evolving as adaptations to varying solar radiation—including UV light —in different geographic locations.[1,2]

Melanin pigments are protective against the deleterious effects of UV radiation, and melanin content

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correlates with the prevention of UV-associated DNA damage.[2] Skin color can be defined as visible pigmentation associated with the absorption and scattering of light from the epidermis, dermis, and underlying structure.[3] An individual's skin color can be either constitutive or facultative.[1,3] Constitutive skin color refers to a genetically predetermined amount of melanin which is not influenced by endogenous or exogenous factors.[3] By contrast, facultative pigmentation reflects the increased level of epidermal melanin content resulting from environmental factors such as exposure to solar radiation or hormones.[3] Primary determinants of skin color include the proportion of eumelanin to pheomelanin, the quantity and size of melanosomes, and the distribution of melanosomes within keratinocytes and melanocytes.[2] Carotenoids, deoxyhemoglobin, and hemoglobin contribute in a minor way to skin color.[2] In contrast to light skin, dark skin is characterized by large singly dispersed melanosomes replete with eumelanin.[2]

CAPSULE SUMMARY

- There is no standard methodology for incorporating skin color and its attendant characteristics into clinical practice or research. The Fitzpatrick skin phototype is most widely used but has known limitations.
- We examine the strengths and limitations of skin classification instruments as a preliminary step toward development of a validated scale.

Race and ethnicity as proxies for skin color

Race encompasses a nonscientific hierarchal concept that divides humans into distinct groups based on inherited physical or behavioral attributes.[4,5] The US Office of Management and Budget (OMB) assigns 5 minimum categories of race: White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or other Pacific Islander.[5] Ethnicity relates to the shared cultural and linguistic values and behaviors of a group. The OMB only recognizes 2 ethnicities: Hispanic/Latino or non-Hispanic/Latino.[5] Although race and ethnicity are socially and culturally constructed classifications, they are frequently used interchangeably in the analysis of primary outcome measures.[4,5] Race and ethnicity are poor surrogates for skin color and fail to capture the full complexity and diversity of human populations.[6] Visscher et al reported only a modest correlation between skin color and race or ethnicity (Table I).[2] To examine this issue, a review of the literature was performed by a panel of dermatologists from the Skin of Color Society to critically evaluate the evidence used to validate the existing scales. The findings are summarized below.

SKIN CLASSIFICATION

In dermatology, baseline assessment of one's skin type provides the clinician and researcher with important information about the patient/research participant. While numerous classification systems for skin color have been developed (Tables II and III), few are widely used, and many are only applicable in limited settings.[8-18,20-24] Rigorously validated skin classification instruments can help to stratify levels of risk, improve the accuracy of assessing disease activity, and monitor adverse events that may otherwise be obscured.[3,25,26] Classification instruments supported by high-quality, validated studies are also necessary for comparing data across clinical trials and meta-analyses and for developing clinical guidelines. Additionally, standardized classification will enhance our comprehension of how diseases differ across various populations.

Fitzpatrick skin phototype classification

Fitzpatrick skin phototypes (FSTs) were developed in 1975 as a tool to aid in the initial dosing of UV-A therapy for White patients diagnosed with psoriasis.[9] After initial observations that phenotypes (hair and eye color) were insufficient to predict one's response to light, a set of questions assessing the personal history of burning and tanning were included to predict tolerance to UV exposure.[9] Over time, the FST has become the standard for skin classification among clinical dermatologists, plastic surgeons, and the industry. Its applications extend beyond its original purpose as it is often employed to describe skin color, infer race/ethnicity, and assess skin cancer risk.[27-31] Despite its extensive use, numerous studies have identified limitations of the FST.[2,26,32]

Although there is an inconsistent correlation between race and objective measures of pigmentation, the FST is often used as a surrogate for race, ethnicity, and skin color assessment in clinical and research settings.[1] A survey of dermatologists found that 31% of respondents use the FST to document race or ethnicity and 47% of respondents use the FST to describe skin color.[1,4] The FST relies on participants' understanding of descriptive language as well as the assessor's level of training.[1] Gupta et al found that between 40% and 60% of individuals could not select a Fitzpatrick

Abbreviations used:

FST: Fitzpatrick skin phototype
OMB: US Office of Management and Budget
PERLA: project on ethnicity and race in Latin America

category due to the limited response options.[32] Eilers et al reported that Black participants described their skin as "getting darker" instead of using the word "tanned."[27] These authors propose using "specific descriptors" for people with SOC, including "skin irritation, tenderness, itching, or skin becoming darker" with sun exposure, to help physicians determine skin phototype and assess skin cancer.[27] Finally, the correlation between the FST and minimal erythema dose has been shown to be inconsistent.[11,33,34] Sanclemente et al found only a 50% correlation between the FST and minimal erythema dose among Colombian high school students.[34]

Beyond Fitzpatrick: Scales that are modifications of the Fitzpatric skin type system

Due to the shortcomings of FST classification, numerous modifications have been developed. Sharma et al adapted the FST for use in Indian populations by expanding the questionnaire to include factors such as eye color, hair color, and unexposed skin color.[18] Holm-Schou et al established a linear correlation between skin cancer phototype and risk by separating questions about burning and tanning tendencies.[19] The authors believed that this modification to the FST improved the precision of quantifying skin cancer risks.[19] The Skin Color Ethnicity scale assists in the assessment of various skin diseases and estimates the risks of cosmetic procedures and medical therapies. This modification refines and expands the original FSTs, providing more precise insights into sunburn risk and wrinkle grading in darker skin tones.[21]

Certain classifications primarily consider skin color, while others incorporate additional characteristics such as dryness, oiliness, and coarseness. Classifications for specific populations—Japanese, Korean, and Indian—have also been developed.[8,18,35] The Lancer Ethnicity Scale, the Fanous Skin Classification, the Goldman World Classification Scale, and the Roberts Skin Type Classification System were developed to predict the likelihood of complications from and response to cosmetic procedures.[10-12,16] These scales factor ancestry, race, skin color, facial features, and history of hyperpigmentation and scarring into estimating the outcomes of procedures such as laser resurfacing and chemical peels.[32,34,36] However, these scales have not been widely applied and have limited applicability in clinical practice and research settings. The Fanous classification system is used during the perioperative evaluation of a trichloroacetic acid chemical peel application in lighter and darker skin patients.[11] Fanous reported a complication rate of 5.9% using this system to estimate risk.[11]

Color-based scales have demonstrated superiority to interview-based classifications when spectrophotometric analyses were used as a reference.[33] Generally, these scales are convenient and cost-effective for clinical use.[14] An example is the Taylor Hyperpigmentation Scale that is comprised of 15 laminated cards, each with 10 gradations of skin color that range from light to dark.[13] Investigators noted the scale's usefulness and ease of use.[13] However, significant intraindividual ($P < .0001$) and interindividual ($P < .0001$) variability were observed when measuring skin hue and hyperpigmentation.[13] More recently, Dadzie et al introduced the Eumelanin Human Skin Colour Scale, which categorizes skin color into 5 quintiles based on published melanin index values of indigenous populations.[20] The authors reported that a corresponding color chart and validation studies are in planning.[20]

Table I. Melanin content and constitutive skin classification

Classification	Melanin Content (μg/mg)*
Racial/ethnic group	3.9
Asian	15
Black/African American	8
Hispanic/Latin American	11
Native Hawaiian/other Pacific Islander White	4.5
Fitzpatrick skin phototype	
I-II	4
III	5.7
IV	11
V-VI	13
Minimal erythema dose range (J/m^2)	
≤225	3.5
226-300	4
301-400	7.3
401-600	9.5
601-800	12.3
≥801	14.3

Adapted with permission from Visscher et al.[2]
*Melanin content determined by integrated density of Fontana-Masson staining of 10 randomly selected areas of skin biopsy samples. High performance liquid chromatography with UV detection was used to chemically analyze melanin content.

GLOSSARY OF TERMS FOR THE PURPOSE OF THIS ARTICLE

- Ethnicity — Belonging to a population group made up of people who share a common cultural background or descent. The OMB designates ethnicity as Hispanic/Latino or not Hispanic/Latino.[5]
- Race — Dynamic nonscientific concept that humans are divided into 5 distinct groups based on inherited physical or behavioral differences. The OMB describes 5 minimum categories of race: White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or other Pacific Islander.[5]
- Skin of color (SOC) — Skin of individuals of African, Latinx, Asian, Native Hawaiian, Pacific Islander, and Indigenous descent.[7]
- Skin color — Visible skin pigmentation determined by the amount, type, and packaging of melanin polymers produced by melanocytes and secreted into keratinocytes and absorption and scattering of light from the dermis; visible skin pigmentation associated with absorption and scattering of light from the dermis.[7]

Finally, skin classification systems have little standardization regarding which areas of skin are included in the assessment. However, it should be noted that the optimal location for skin measurement depends on the clinical goals: evaluation should occur at the area of interest for assessing improvement or progression of pigmentation.

Objective noninvasive devices are not widely available and are cost-prohibitive in routine clinical practice.[4] Table IV provides a snapshot of noninvasive objective measures used for investigating skin color in the context of postinflammatory hyperpigmentation.[36-40] A systematic review found that commercially available colorimeters demonstrated good inter/intraobserver reliability for color (4 studies; intraobserver reliability ranged from 0.84 to 0.99, and interobserver reliability ranged from 0.54 to 0.99), with consistent results across devices; however, colorimetric and spectrophometric analyses require validated and universal methodologies including illuminants, measurement systems, and measurement methodologies to allow for study to study evaluation and comparison.[38,40] Notably, measures that depend on digital imaging are significantly affected by lighting quality and operator expertise.[38]

RELEVANCE TO CLINICAL PRACTICE AND RESEARCH

Disease characteristics and clinical outcomes may vary between patients with lightly versus darkly pigmented skin. For example, erythema is more difficult to detect in individuals with darker skin tones, which may lead to the underestimation of disease severity and inadequate treatment. Simmons-O'Brien et al found that moderate to severe facial erythema in patients with SOC was not visible in clinical grading.[41] Bosma et al found differences in the clinical presentation of atopic dermatitis for patients with light skin (defined as Fitzpatrick types I-III) vs those with dark skin (types IV-VI).[42] Compared to lighter skin patients, patients with darker skin had higher eczema area severity index scores at baseline ($P = .009$) and were more likely to have follicular eczema ($P < .001$).[42] Furthermore, the authors speculated that differences in skin type "may influence treatment effectiveness," with greater improvements observed in dark-skinned patients after dupilumab treatment but not after methotrexate or cyclosporine.[42] In a retrospective study, Cole et al reported differences in bullous pemphigoid disease activity index scores based on self-identified race and investigator-assigned Fitzpatrick skin type.[43] Compared to White patients, Black patients were found to have significantly higher levels of anti-VP180 IgG (71.9 [75.5] for Black patients vs 37.9 [49.1] for White patients) and anti-bullous pemphigoid 230 IgG (45.6 [59.0] vs 16.9 [31.2]) and peripheral eosinophil counts (1136.1 [1959.8] vs 281.1 [320.4], $P = .001$).[43] Disease activity did not significantly differ between Black and White patients, but lower urticaria/erythema scores in the former may explain this observation.[43] Disease severity indices which include erythema may have the potential to influence severity scores. However, Zhao et al found that the presence of erythema did not affect the interrater and intrarater reliability of eczema area severity index scores in patients with SOC.[44]

Dermatology clinical trials have poor representation of minoritized patient populations.[45] In 2020, Reddy et al identified 62 phase 3 psoriasis clinical trials that included data on race and ethnicity; among these, almost 86% of study participants were White.[46] For hidradenitis suppurativa, which disproportionately affects Black/African Americans, just 14.0% of recent phase 2 and 3 trial participants were of African descent, even when the trials were conducted in areas with diverse populations.[47] In contrast, Charrow et al found representation similar to the

Table II. Skin classification systems

Scale, y	Description of scale	Purpose	Comments
Von Luschan Chromatic Scale, 1908	• Opaque glass tile scale: lightest score of 1 to the darkest score of 36	• To assesses skin color	• Variation in color perception of glass tiles
Kawada Skin Classification for Japanese Individuals, 1986[8]	• Three skin types: I (always burn and rarely tan), II (moderately burn and moderately tan), and III (never burn and always tan)	• To describe Japanese skin types' sensitivity and response to UV light, sunburn, and tanning	• Limited to Japanese population • Limited validation studies
Fitzpatrick Skin Type, 1975, 1988[9]	• Questionnaire based on genetic predisposition, sun exposure reaction, and tanning habits • Six skin types: I (never tans, always burns; extremely fair skin), II (occasionally tans, usually burns; fair skin), III (often tans, sometimes burns; medium skin), IV (always tans, never burns; olive skin), V (never burns; dark brown skin), and VI (never burns; black skin)	• Initially developed to estimate correct PUVA dosage for psoriasis patients • Later used to describe skin color, predict skin cancer risk, and predict response/complications to various dermatologic procedures	• Widely used, convenient, and easy to administer. • Difficulty in understanding of subjective terms of burning and tanning reported in certain populations • Inconsistent correlation with MED • Skin types IV-V based on skin color rather than UV response
Lancer Ethnicity Scale, 1998[10]	• Five skin types based on ancestral background: 1-2 (European), 3 (North American or European), 4 (Latin/Central/South American or Asian or African), and 5 (African)	• To determine likelihood of complications after cosmetic procedures	• Categorizes groups based on race • Limited validation studies
Fanous Classification, 2002[11]	• Six racial and ethnic categories: Nordic, European, Mediterranean, Indo-Pakistanis, Africans, and Asians • Skin is categorized based on its texture and degree of pigmentation	• To predict response and risks to cosmetic procedures	• Limitations: categorizes groups based on race and places a higher value on European groups • Strengths: predictive validation study to support use in Trichloroacetic acid peel (jama plastic surg ref)
Goldman World Classification of Skin Types, 2002[12]	• Multiple factors describe skin types: skin color, response to burning/tanning, and postinflammatory hyperpigmentation	• Predicts melanocyte response to laser, surgical, or chemical injury	
Taylor Hyperpigmentation Scale, 2005[13]	• Visual color scale • Fifteen cards each with 10 bands of increasingly darker gradations of skin hue	• Estimates baseline pigmentation and hyperpigmentation after therapy	• Inexpensive • Investigators noted ease of use. • Significant intraindividual and interindividual variability • Limited validation data
Konishi Skin Tone Color Scale, 2007[14]	• Plastic color bar with 5 hue bars, 19 color values attached to each bar • Based on Munsell' color space system	• Assesses normal skin color and pigmented lesions	• Inexpensive • Training required to improve accuracy • Detected changes in V value correlated with overall physician assessment

Continued

Table II. Cont'd

Scale, y	Description of scale	Purpose	Comments
Baumann Skin Type, 2008[15]	• Sixteen skin types based on 4 parameters: hydration, skin sensitivity, pigmentation, and elasticity	• To create personalized skin care recommendations	
Roberts Skin Type Classification System, 2008[16]	• Four parameters: phototype, photoaging, hyperpigmentation, and scarring propensity • Classification scales used: Fitzpatrick Phototype, Roberts Hyperpigmentation, Glogau, and Roberts Scarring	• To predict response to insult, injury, and inflammation • To determine the effectiveness/risks of treatments	• Validation testing not performed
Color Bar Tool for Skin Type Self-identification, 2015[17]	• Six color bars with increasingly darker gradations of skin hue • Participants select the color bar that most resembles their skin		• Low cost • Linear correlation with melanin index ($P < 0.0001$) and modified Fitzpatrick questionnaire ($P < .04$) • Participant cultural biases may affect color selection
Modified Fitzpatrick Skin Type, 2018[18]	• Expansion of 3 Fitzpatrick questionnaire items (eye color, natural hair color, and color of unexposed skin); items on tanning habits removed • Modified for use in Indian population	• To assess phototype, skin color, and propensity to burn/tan in Indian skin types	• Limited population; requires validation in more diverse setting
Skin Cancer Phototype Scale, 2019[19]	• Based on FST but includes separate questions for erythema and pigmentation	• To predict skin cancer risk	• Retrospective data in limited population; findings may not be generalizable • Known group validity • Concurrent validity
Dadzie Eumelanin Human Skin Colour Scale, 2022[20]	• Eumelanin scale based on MI; groups skin color into 5 categories: low (MI < 25), low intermediate (MI 25 to <50), intermediate (MI 50 to <75), intermediate high (MI 75 to <100), and high (MI 100 and greater)	• To provide complete range of human constitutive skin color • To describe human skin color in equitable manner	• Development of corresponding color chart in progress • Validation studies are planned
The Skin Color Ethnicity Scale, 2023[21]	• Modification and expansion of Fitzpatrick Scale's 4 parameters: racial and ethnic homeland, aging, scarring and hyperpigmentation, and colorimetry. • Skin types I, II, III, IVA and B, VA and B, and VI.	• Inclusive scale to assist in assessment of skin disease and estimate risk of cosmetic procedures and medical therapies	• Validation studies are planned

FST, Fitzpatrick skin phototype; *MED*, minimal erythema dose; *MI*, melanin index; *PUVA*, psoralen plus ultraviolet A light; *TCA*, trichloroacetic acid.

general population in racial and ethnic groups in trials of acne, vitiligo, and atopic dermatitis.[25] Akintilo et al's study analyzing the demographics of cosmetic clinical trials found that 74.9% of subjects were White in industry-sponsored studies compared to 38.0% in nonindustry-sponsored trials ($P = .0012$).[48] These authors also noted that many protocols of cosmetic trials targeted White-centric treatment goals that may not be well suited to individuals with darker skin.[48] As work is ongoing to improve data reporting and broaden representation of research participants, it is critical to move

Table III. Color scales used outside of dermatology

Scale, y	Description of scale	Purpose	Comments
Martin–Massey New Immigrant Survey (NIS) Skin Color Scale, 2003[22]	• Animated skin tone scale: lightest score of 0 to the darkest score of 10	• Assesses skin color • Helps detect immigrant discrimination based on skin color	• Inconsistent skin tone assessment results • Used outside of dermatologic settings
PERLA Color Palette, 2008*	• Skin color palette: lightest score of 1 to the darkest score of 11	• Used in surveys exploring racial discrimination and attitudes in Latin America	• Not used in dermatologic settings
Monk Skin Tone Scale, 2022†	• Shade scale: lightest score of 0 to the darkest score of 10	• Trains facial recognition artificial intelligence programs	

PERLA, Project on Ethnicity and Race in Latin America.
*PERLA (Project on Ethnicity and Race in Latin America). Accessed at https://perla.soc.ucsb.edu/about-perla.
†Monk EP Jr The Monk Skin Tone Scale. Accessed at https://osf.io/preprints/socarxiv/pdf4c/.

beyond racial and ethnic categories to include variables that can provide better insight into the biological behavior of skin.

LOOKING AHEAD

Developing a validated skin classification instrument is a challenging but critical next step toward eliminating the improper use of race and Fitzpatrick skin types in dermatology. Currently, most skin classification instruments lack high-quality validation data to support their use. The Harmonizing Outcome Measures for Eczema initiative is a model of how stakeholders can successfully standardize outcome measures in atopic dermatitis.[49] Harmonizing Outcome Measures for Eczema provides a structured approach to identifying key disease-based domains and corresponding measurement tools and to determining if current or new instruments should be validated.[49] Although not disease-focused, a similar consensus-driven process can be used to identify and validate the essential parameters for a skin classification tool. Similar to the Harmonizing Outcome Measures for Eczema working groups, a consensus group should include a broad range of international stakeholders, including dermatologists, researchers, experts, dermatology society leadership, methodologists, patient advocates, clinical trialists, regulatory authorities, health policy experts, and pharmaceutical company representatives.

In the interim, educational efforts should aid dermatologists and nondermatologists in understanding the nuances of assessing differences in disease presentation between light and dark skin. We encourage researchers to look beyond Fitzpatrick skin types for participant classification in dermatologic studies; measures of skin color could potentially provide more compelling data and should be guided by the study design. Furthermore, it is crucial to critically evaluate clinical trial protocols to ensure they are designed to recruit diverse participants and include clinically meaningful endpoints (ie, hyperpigmentation) that are relevant across different patient cohorts.

At present, and perhaps even in the future, there may not be a single instrument that meets all needs. The terminology used to describe race, ethnicity, and skin type is a current limitation of the evidence. While it is evident that there is more to skin classification than just color, how pigmentation, genetic ancestry, social and environmental factors, and other cutaneous characteristics intersect to influence disease outcomes is not fully known. In the future, research studies may rely primarily on objective measures, particularly if artificial intelligence technologies become more inclusive and robust.

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Conflicts of interest

Dr Harvey has served as a consultant for L'Oréal and SkinCeuticals and on advisory boards for AbbVie, Lilly, Bristol-Myers Squibb, and Johnson & Johnson. Dr Alexis has received grants (funds to institution) from LEO Pharma, Novartis, Almirall, Bristol-Myers Squibb, Amgen, Vyne, Galderma, Valeant (now Bausch Health), Cara Therapeutics, Arcutis, Dermavant, AbbVie, and Castle; on advisory board or as a consultant for LEO Pharma, Galderma, Pfizer, Sanofi-Regeneron, Dermavant, Beiersdorf, Ortho, L'Oréal, BMS, Bausch Health, UCB, Vyne, Arcutis, Janssen, Allergan, Almirall, AbbVie, Amgen, VisualDx, Eli Lilly, Swiss American, Cutera, Cara Therapeutics, EPI Health, Incyte, Castle, Apogee, Alphyn, and Canfield; as a speaker for Regeneron, Sanofi-Genzyme, Pfizer, and BMS; and has received royalties from Springer, Wiley-Blackwell, and Wolters Kluwer Health. Dr McKinley-Grant has served as a consultant for Janssen and Determi-Nation. Dr Taylor has served as a consultant/advisor/speaker for AbbVie, Arcutis Biotherapeutics, Inc, Armis Scientific, Avita Medical,

Table IV. Objective skin color measurement devices

Technique	What is assessed	Clinical application	Comments
UV light photography	Epidermal melanin	• Visualization of epidermal pigment	• Limited utility in clinical settings
Cross-polarized light photography	Reduces reflection allowing for visualization of deeper cutaneous structures	• Used to assess changes in pigmentation and erythema. • Used as a complement to standard photography	• Reduces ability to accurately distinguish lesion morphology • Increased color contrast improves visualization of inflammation erythema in darker skin[37]
Tristimulus colorimetry	Melanin indices, erythema, and tanning ability	• Quantification of pigmentation and erythema • Assess bruising and scarring • Monitor and assess efficacy of treatment	• Reproducibility and accuracy influenced by individual, environmental, and/or device related factors[38]
Diffuse reflectance spectroscopy	Melanin and vasculature	• Quantification of pigmentation and erythema	• Limited utility in clinical settings
Hyperspectral imaging	Melanin and vasculature	• Quantification of pigmentation and erythema	• Limited utility in clinical settings
Reflectance confocal microscopy	High resolution in vivo analysis of skin structures-approaching accuracy of histology	• Visualization of pigmentation • Detection of melanocytic and nonmelanocytic neoplasms and vasculature in superficial dermis	• Cost • Four-6 mo of training needed to achieve diagnostic accuracy • Decreased resolution in mid to deep dermis. • Structural elements are difficult to elucidate in lighter skin types (ie, basal keratinocytes and dermal papillary rings)[39]
Tristimulus colorimetry with L*a*b* color system	Melanin, erythema, skin color	• Quantification of pigmentation and erythema	• Limited utility in clinical settings
Narrow band reflectance spectrophotometry	Measures erythema and melanin indices, skin color	• Quantification of pigmentation and erythema • Monitor and assess efficacy of treatment	• Increase cost limited utility in clinical settings • Time consuming: must obtain the average of multiple readings • Limited ability to differentiate metameric colors • Reproducibility and accuracy influenced by individual, environmental, and/or device related factors[40]

Adapted from Silpa-Archa et al and Langeveld et al.[36,38]

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REFERENCES

1. Jablonski NG. Skin color and race. *Am J Phys Anthropol*. 2021;175:437-447.
2. Visscher MO. Skin color and pigmentation in ethnic skin. *Facial Plast Surg Clin North Am*. 2017;25:119-125.
3. Brenner M, Hearing VJ. The protective role of melanin against UV damage in human skin. *Photochem Photobiol*. 2008;84:539-549.
4. Ware OR, Dawson JE, Shinohara MM, Taylor SC. Racial limitations of Fitzpatrick skin type. *Cutis*. 2020;105:77-80.
5. United States Office of Management and Budget. Updated reference: Office of Management and Budget. Revisions to the standards for the classification of federal data on race and ethnicity. *Federal Register*. 1997;62(210):58782-58790.
6. Flanagin A, Frey T, Christiansen SL, AMA Manual of Style Committee. Updated guidance on the reporting of race and ethnicity in medical and science journals. *JAMA*. 2021;326:621-627.
7. Iwuala C, Taylor SC. Structural and functional differences in skin of colour. *Clin Exp Dermatol*. 2022;47:247-250.
8. Kawada A. UVB-induced erythema, delayed tanning, and UVA-induced immediate tanning in Japanese skin. *Photo Dermatol*. 1986;3:327-333.
9. Fitzpatrick TB. The validity and practicality of sun-reactive skin types I through VI. *Arch Dermatol*. 1988;124:869-871.
10. Lancer HA. Lancer ethnicity scale (LES). *Lasers Surg Med*. 1998;22:9.
11. Fanous N. A new patient classification for laser resurfacing and peels: predicting responses, risks, and results. *Aesthetic Plast Surg*. 2002;26:99-104.
12. Goldman N. Universal classification of skin type. *J Cosmet Dermatol*. 2002;15:53-54, 7.
13. Taylor SC, Arsonnaud S, Czernielewski J, Hyperpigmentation Scale Study Group. The Taylor Hyperpigmentation Scale: a new visual assessment tool for the evaluation of skin color and pigmentation. *Cutis*. 2005;76:270-274.
14. Konishi N, Kawada A, Morimoto Y, et al. New approach to the evaluation of skin color of pigmentary lesions using Skin Tone Color Scale. *J Dermatol*. 2007;34:441-446.
15. Baumann L. Understanding and treating various skin types: the Baumann skin type indicator. *Dermatol Clin*. 2008;26:359-373, vi.
16. Roberts WE. The Roberts skin type classification system. *J Drugs Dermatol*. 2008;7:452-456.
17. Ho BK, Robinson JK. Color bar tool for skin type self-identification: a cross-sectional study. *J Am Acad Dermatol*. 2015;73:312-313.e1.
18. Sharma VK, Gupta V, Jangid BL, et al. Modification of the Fitzpatrick system of skin phototype classification for the Indian population, and its correlation with narrowband diffuse reflectance spectrophotometry. *Clin Exp Dermatol*. 2018;43:274-280.
19. Holm-Schou AS, Philipsen PA, Wulf HC. Skin cancer phototype: a new classification directly related to skin cancer and based on responses from 2869 individuals. *Photodermatol Photoimmunol Photomed*. 2019;35:116-123.
20. Dadzie OE, Sturm RA, Fajuyigbe DP, et al. The eumelanin human skin colour scale: a proof-of-concept study. *Br J Dermatol*. 2022;187:99-104.
21. Coleman W, Mariwalla K, Grimes P. Updating the Fitzpatrick classification: the skin color and ethnicity scale. *Dermatol Surg*. 2023;49:725-731.
22. Massey DS, Martin J. The NIS skin color scale, 2003. Accessed November 30, 2023. https://nis.princeton.edu/downloads/nis-skin-color-scale.pdf
23. Glogau R. Chemical peeling and aging skin. *J Geriatr Dermatol*. 1994;12:31.
24. Swiatoniowski AK, Quillen EE, Shriver MD, et al. Technical note: comparing von Luschan skin color tiles and modern spectrophotometry for measuring human skin pigmentation. *Am J Phys Anthropol*. 2013;151:325-330.
25. Charrow A, Xia FD, Joyce C, et al. Diversity in dermatology clinical trials: a systematic review. *JAMA Dermatol*. 2017;153:193-198.
26. Perez K, Steppe C, Teotia SS, et al. Does Fitzpatrick score predict flap loss? Microsurgical breast reconstruction outcomes of varying skin color. *Plast Reconstr Surg Glob Open*. 2022;10:e4637.

27. Eilers S, Bach DQ, Gaber R, et al. Accuracy of self-report in assessing Fitzpatrick skin phototypes I through VI. *JAMA Dermatol*. 2013;149:1289-1294.
28. Ravnbak MH. Objective determination of Fitzpatrick skin type. *Dan Med Bull*. 2010;57:B4153.
29. Okoji UK, Taylor SC, Lipoff JB. Equity in skin typing: why it is time to replace the Fitzpatrick scale. *Br J Dermatol*. 2021;185:198-199.
30. He SY, McCulloch CE, Boscardin WJ, et al. Self-reported pigmentary phenotypes and race are significant but incomplete predictors of Fitzpatrick skin phototype in an ethnically diverse population. *J Am Acad Dermatol*. 2014;71:731-737.
31. Trakatelli M, Bylaite-Bucinskiene M, Correia O, et al. Clinical assessment of skin phototypes: watch your words! *Eur J Dermatol*. 2017;27:615-619.
32. Gupta V, Sharma VK. Skin typing: Fitzpatrick grading and others. *Clin Dermatol*. 2019;37:430-436.
33. Chung JH, Koh WS, Youn JI. Relevance of skin phototyping to a Korean population. *Clin Exp Dermatol*. 1994;19:476-478.
34. Sanclemente G, Zapata JF, Garcia JJ, et al. Lack of correlation between minimal erythema dose and skin phototype in a Colombian scholar population. *Skin Res Technol*. 2008;14:403-409.
35. Willis I, Earles RM. A new classification system relevant to people of African descent. *J Cosmet Dermatol*. 2005;18:209-216.
36. Silpa-Archa N, Kohli I, Chaowattanapanit S, Lim HW, Hamzavi I. Postinflammatory hyperpigmentation: a comprehensive overview: epidemiology, pathogenesis, clinical presentation, and noninvasive assessment technique. *J Am Acad Dermatol*. 2017;77:591-605.
37. Oh Y, Markova A, Noor SJ, Rotemberg V. Standardized clinical photography considerations in patients across skin tones. *Br J Dermatol*. 2022;186:352-354.
38. Langeveld M, van de Lande LS, OS E, van der Lei B, van Dongen JA. Skin measurement devices to assess skin quality: a systematic review on reliability and validity. *Skin Res Technol*. 2022;28:212-224.
39. Levine A, Markowitz O. Introduction to reflectance confocal microscopy and its use in clinical practice. *JAAD Case Rep*. 2018;4:1014-1023.
40. Ly BCK, Dyer EB, Feig JL, Chien AL, Del Bino S. Research techniques made simple: cutaneous colorimetry: a reliable technique for objective skin color measurement. *J Invest Dermatol*. 2020;140:3-12.e1.
41. Simmons-O'Brien E, Callender VD, Orlinsky D, Hassan S, Okeke CAV, Byrd AS. Exploring the importance of inclusion criteria beyond the color of skin: improvement in facial redness in skin of color subjects-An open-label, single center clinical study utilizing low molecular weight heparan sulfate. *J Am Acad Dermatol*. 2023;88:1204-1206.
42. Bosma AL, Ouwerkerk W, Heidema MJ, et al. Comparison of real-world treatment outcomes of systemic immunomodulating therapy in atopic dermatitis patients with dark and light skin types. *JAAD Int*. 2023;10:14-24.
43. Cole EF, Mustin DE, Feldman RJ. The effect of skin colour and Fitzpatrick skin type on Bullous Pemphigoid Disease Area Index (BPDAI) scores. *Br J Dermatol*. 2022;187:606-607.
44. Zhao CY, Wijayanti A, Doria MC, et al. The reliability and validity of outcome measures for atopic dermatitis in patients with pigmented skin: a grey area. *Int J Womens Dermatol*. 2015;1:150-154.
45. El-Kashlan N, Alexis A. Disparities in dermatology: a reflection. *J Clin Aesthet Dermatol*. 2022;15:27-29.
46. Reddy VD, Myers BA, Chan SY, et al. A review of current phase III clinical trials of plaque psoriasis: under-representation of nonwhite participants and need for reform. *Br J Dermatol*. 2021;184:348-350.
47. Okeke CAV, Perry JD, Simmonds FC, et al. Clinical trials and skin of color: the example of hidradenitis suppurativa. *Dermatology*. 2022;238:180-184.
48. Akintilo L, Pulavarty A, Onwudiwe O, Garibyan L, Lee K. Skin of color representation in cosmetic clinical trials: a literature review. *Lasers Surg Med*. 2022;54:819-822.
49. Williams HC, Schmitt J, Thomas KS, et al. The HOME Core outcome set for clinical trials of atopic dermatitis. *J Allergy Clin Immunol*. 2022;149:1899-1911.