
Confusions about color: Formulating a more precise lexicon for pigmentation, pigmentary disorders, and abnormalities of “chromatics”

James J. Nordlund, MD,^a Jean-Paul Ortonne, MD,^b Tania Cestari, MD,^c
Pearl Grimes, MD,^d and Henry Chan, MD^e
*Dayton and Mason, Ohio; Nice, France; Rio Grande do Sul, Brazil;
Los Angeles, California; and Hong Kong*

THE PROBLEM

Skin color is an extraordinarily complex subject. There is no standard definition of usual or normal skin color. Abnormal skin color is a result of a vast array of alterations in the skin, from blood flow to deposition of chemicals, to alterations in the morphology of the skin, and more. To make the subject even more difficult, there is no standard language, jargon, or lexicon used throughout the dermatological community, much less the medical community at large, to describe these abnormalities. Yet precise, accurate language is the basis for education, for communication, for investigative and therapeutic strategies. The critical need for a precise lexicon is strongly emphasized by the National Institutes of Health lexicon project that seeks to develop a consistent jargon for dermatology as a discipline.¹ The Pigmentary Disorders Academy (PDA), a group of dermatologists with strong interests in normal and abnormal pigmentation, has coordinated this article and the concepts with the program sponsored by the National Institutes of Health to devise a consensus lexicon for skin color, normal and abnormal. Encouragement to use this new terminology should

Table I. Chromophores that contribute to skin color

Melanotic	Nonmelanotic (chromatics)
Melanin	Collagen
Eumelanin and/or pheomelanin	
Melanocytes	Carotene or lycopene
Melanin in melanophages	Other chemicals or drugs
	Oxyhemoglobin
	Reduced hemoglobin
	Other

result in more astute diagnosis and decision on therapy.

SKIN COLOR

A number of chemicals contribute to skin color (Table I). A major determinant of skin color is melanin, its quantity, type, distribution, and location of melanin within the epidermis and dermis. Other significant determinants are capillary blood flow,²⁻⁴ chromophores such as carotene or lycopene,^{5,6} and collagen in the dermis (James Nordlund, personal communication, February 7, 2006). Physical factors also are involved in the observed skin color.^{2,7,8} These include the spectrum of light striking the skin, the reflection, refraction and absorption of light, and the transparency of the stratum corneum and epidermis.

There is no color that defines normal skin. Populations with various skin colors have evolved over time so that skin color varies from very light with red (Celtic) or blond (Scandinavian) hair to very dark (African) or almost to black (Australian aborigine)^{9,10} (Fig 1). In between are the peoples of India who have brown-black skin. Asians and indigenous American peoples have a yellow tan to reddish tan coloration. The evolutionary value of skin color has been studied and discussed in depth. Recent reviews

From the Department of Dermatology, Wright State School of Medicine, Dayton and Group Health Associates, Mason^a; the Department of Dermatology, University of Nice-Sophia Antipolis^b; the Department of Dermatology, University of Rio Grande do Sul, Hospital de Clínicas^c; Vitiligo & Pigmentation Institute of Southern California, Los Angeles, and the Division of Dermatology, University of California, Los Angeles^d; and the Division of Dermatology, University of Hong Kong.^e

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Correspondence to: James J. Nordlund, MD, Group Health Associates, Cincinnati, Ohio. E-mail: jjnordlund@fuse.net.

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Fig 1. Human skin color, its varieties and variations. From Nordlund JJ, Boissy RE, Hearing VJ, King RA, Ortonne J-P, editors. *The pigimentary system: physiology and pathophysiology*. New York: Oxford University Press; 1998. Reprinted with permission from Blackwell Publishing Ltd.

suggest that for peoples living between the tropics of Cancer and Capricorn, a dark skin provides a natural advantage against the deleterious effects of the sun.^{11,12} Sunburn was an impediment to gathering or hunting for food. Melanin also protected against photolysis of essential nutrients, such as folic acid, that likely were available in limited quantities.¹² For those living north or south of these tropical latitudes, it has been postulated that sexual selection chose lighter skin as preferable.¹²

THE CHEMISTRY OF SKIN COLOR

For the most part, the color of skin is determined by the pigmentary system, that is, the quantity, type, and distribution of melanin in the skin. There are two types of melanin. Eumelanin is brown or black and is more abundant in darker skin of Africans and East Indians. It is produced exclusively from the amino acid tyrosine. Pheomelanin is reddish or orange and is more abundant in red hair and the red-brown freckles of Celtic populations. It is synthesized from two amino acids, tyrosine and cysteine. The synthesis of either type of melanin is a complex multistep process catalyzed by at least one or several enzymes, the most well known being tyrosinase.^{9,10} Results of recent studies suggest that red hair and freckles are a manifestation of a mutation in the receptor for α -melanocyte stimulating hormone, which preferentially stimulates production of eumelanin.¹³

Other than the type and quantity of melanin, epidermis obtained from individuals of all ethnic groups morphologically appears to be the same. The population density of melanocytes in dark skin is similar to that in light skin.¹⁴⁻¹⁶ There is considerable discussion whether dark and light skin function in identical manners.¹⁷⁻²² Skin disorders such as dermatitis or pityriasis rosea have a different appearance in light and dark skin, an observation that suggests there are subtle functional differences.

THE PHYSICS OF SKIN COLOR

The color of any object as perceived by an individual is determined by the spectrum of light that is reflected or emitted from the object and impinges on the retina of the observer. Chemicals or chromophores in the skin absorb or reflect incident light to produce the colors we observe. The importance of reflected and absorbed light in humans is underscored by the phenomenon termed iridescence.²³

Human skin can take on a blue hue due to iridescence. Some patients taking minocycline acquire a blue discoloration on the tibial surfaces due to deposition of minocycline chelated with divalent cations, like iron (chemically black) in the dermis.



Fig 2. Patient with poikiloderma of Civatte referred for evaluation of “depigmentation,” possibly vitiligo vulgaris. White macules are caused by scarring and fibrosis in dermis. Erythema is caused by dermal capillary engorgement. The quantity of melanin in the epidermis in a biopsy specimen taken from the white skin was equal to that in the red skin determined by Fontana Masson stains. This type of leukoderma is not a pigmentary problem but a form of nonmelanotic achromia. Figure courtesy of Dr James Nordlund.

There are many examples of iridescence such as the blue of irides, the sacral spot in babies, the nevus of Ota and Ito, and tattoos.

ABNORMALITIES OF SKIN COLOR

There are many mechanisms by which skin color can become abnormal.²⁴ Any of the components that contribute to skin color (Table I) can be deficient or excessive within the skin and produce abnormal skin color. Excessive capillary blood flow produces rosacea or a nevus flammeus, manifested as a red discoloration of the skin. Beta-carotene or lycopene impart a yellowish cast to the skin. Collagen in the dermis make the skin appear whitish. Excessive or deficient amounts of melanin caused by any mechanism cause hyperpigmentation or hypopigmentation, respectively. Language must be able to distinguish the various forms of skin color changes in a clear, precise, and simple manner.

CONFUSING TERMS

How clinicians describe the appearance of a skin disorder is a major determinant of how that disorder is classified.¹ The classification of a disorder is the basis for therapeutic strategies. An acne abscess incorrectly is considered to be infected because it is an abscess full of neutrophils when in fact it is a sterile cavity where no bacteria are likely to survive. For the uninformed physician, high-dose antibiotics and incision with drainage are the treatment of choice when in truth an injection of a steroid as an anti-inflammatory agent is properly indicated.

Normal and abnormal discoloration of the skin often is inaccurately described. A nevus depigmentosus is rarely depigmented (total absence of

Table II. Hyperchromias

Melanotic (hyperpigmentation)						Mixed hyperpigmentation and hyperchromia					
Hypermelanosis			Hypermelanocytosis			Nonmelanotic (hyperchromia)					
Congenital			Acquired			Congenital			Acquired		
Localized	Variable	General	Localized	Variable	General	Localized	Variable	General	Localized	Variable	General
Epi	Der	Mix	Epi	Der	Mix	Epi	Der	Mix	Epi	Der	Mix
Epi	Der	Mix	Epi	Der	Mix	Epi	Der	Mix	Epi	Der	Mix

Der, Dermal; *Epi*, epidermal; *Mix*, mixed epidermal and dermal.

Table III. Hypochromia or achromias (leukoderma)*

Melanotic						Mixed hypopigmentation and hypochromia					
Melanopenia			Melanocytopenia			Nonmelanotic (hypochromia/achromia)					
Congenital			Acquired			Congenital			Acquired		
Localized	Variable	General	Localized	Variable	General	Localized	Variable	General	Localized	Variable	General
Epi			Epi	Der	Mix	Epi	Der	Mix	Epi	Der	Mix
Epi			Epi	Der	Mix	Epi	Der	Mix	Epi	Der	Mix

Der, Dermal; *Epi*, epidermal; *Mix*, mixed epidermal and dermal.

*Each group can be divided into genetic and nongenetic.

melanin) but typically is hypopigmented (partial loss of melanin). Various forms of leukoderma attributable to deposition of collagen in the dermis (James Nordlund, personal communication, February 7, 2006), such as scars, are described as hypopigmented. (Fig 2) Histology often confirms that the quantity of melanin overlying the scar is equivalent to that in surrounding skin.²⁵ Thus the whitish color is not attributable to abnormalities of the pigmentary system. However, treatments such as psoralens plus UVA to repigment the skin are prescribed.

It is very common to hear a dermatologist label hydroquinone as a bleach. Hydroquinone is an inhibitor for production of new melanin and has no bleaching effects on existing melanin, whether it be in the epidermis or dermis. Thus it can be effective only for treating excessive melanin in the epidermis by blocking formation of new melanin. The improper use of the word "bleach" causes the confusion.

Segmental vitiligo affects a part of the body, typically on one side. The words "segmental vitiligo" are considered equivalent to "dermatomal vitiligo." The terms have become so interchangeable that theories for the pathogenesis of segmental vitiligo are based on the innervation of the skin. Treatments have been proposed based on proposed abnormalities in the innervation of the skin.²⁶ In fact, segmental vitiligo is almost never dermatomal and the patterns rarely resemble one or even several dermatomes.²⁷

In everyday parlance, the word "pigment" means a dry substance or chemical used to color or tint an object for printing or for painting pictures. In dermatology it is well recognized that there are a list of chemicals that affect the color of the skin. (Table I).

Confusion arises if a nevus flammeus is described as hyperpigmented. The dyes of tattoos are genuine pigments. However, tattoos are not considered to be forms of "hyperpigmentation."

A PERSPECTIVE AND PROPOSAL

The PDA has come to recognize the problems of imprecise language and proposes a more accurate and reproducible terminology that conveys precise concepts.

It is proposed (Table I) that all chemicals and structural items that impart color to the skin be called chromophores. Chromophores can be divided into two types, that is, melanotic (of or pertaining to melanin) and nonmelanotic (of or pertaining to non-melanin substances). It is proposed that the words "pigment," "pigmentation," "hypopigmented," "depigmented," and "hyperpigmented" be restricted to melanin, melanocytes, disorders and conditions related to or excessive or depleted quantities of melanocytes/melanin. That is, the word "pigmentation" should be reserved for descriptions of skin color and its abnormalities related to melanocytes and melanin, that is, the pigmentary system. There are just a few basic categories of pigmentary disorders, those characterized by too much or too little melanin and those related to too few or too many melanocytes.

The PDA proposes some neologisms to distinguish discolorations of the skin caused by non-melanotic components from those caused by the pigmentary system. It is necessary to develop new words since there are no other English lay or scientific words extant that can do the job. Nonmelanotic

Table IV. A classification of the disorders of skin color

I. Hyperchromia

A. Melanotic types of hyperchromia (hyperpigmentation)

1. Hypermelanosis (increased melanin only and normal population density of melanocytes)
 - a. Congenital
 - i. Localized, variable, or generalized
 - ii. Epidermal, dermal, or mixed
 - b. Acquired
 - i. Localized, variable, or generalized
 - ii. Epidermal, dermal, or mixed
2. Hypermelanocytosis (increased melanocytes and melanin)
 - a. Congenital
 - i. Localized, variable, or generalized
 - ii. Epidermal, dermal, or mixed
 - b. Acquired
 - i. Localized, variable, or generalized
 - ii. Epidermal, dermal, or mixed

B. Nonmelanotic types of hyperchromia

1. Congenital
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed
2. Acquired
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed

C. Mixed hypermelanoses and hyperchromias

1. Congenital
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed
2. Acquired
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed

II. Hypochromia or achromia (leukoderma)

A. Melanotic types of leukoderma (hypopigmentation or depigmentation)

1. Hypomelanosis or amelanosis (decreased melanin only)
 - a. Congenital
 - i. Localized, variable, or generalized
 - ii. Epidermal
 - b. Acquired
 - i. Localized, variable, or generalized
 - ii. Epidermal
2. Hypomelanocytosis or amelanocytosis (partial or total absence of melanocytes)
 - a. Congenital
 - i. Localized, variable, or generalized
 - ii. Epidermal
 - b. Acquired
 - i. Localized, variable, or generalized
 - ii. Epidermal

B. Nonmelanotic hypochromia

1. Congenital
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed

Table IV. Cont'd

2. Acquired
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed
- C. Mixed hypopigmentation and depigmentation and nonmelanocytic hypochromia
 1. Congenital
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed
 2. Acquired
 - a. Localized, variable, or generalized
 - b. Epidermal, dermal, or mixed

factors that affect skin color are properly called “chromatics” (Table I). Nonmelanotic abnormalities of skin color can be called dyschromias and the words “hyperchromia” (Table II) and “hypochromia” (Table III) used to describe abnormally darker or lighter skin, respectively. Thus all nonpigmentary chromophores that alter normal skin color fit into these categories of dyschromias be they vascular, chemical, deposits, collagen, or other.

Leukodermas (ie, hypochromias or achromias) (Table III) can be forms of hypopigmentation or depigmentation produced by partial or total loss of melanin from the epidermis (no dermal variant possible). Alternatively, leukoderma can be a type of hypochromia produced by deposition of collagen in the dermis (scar), decreased blood flow as nevus anemicus or Wernoff’s ring, or by dermal edema. Review of the more than 200 disorders of skin color⁹ confirms that all abnormalities fit precisely and informatively into this scheme.

It is possible to describe normal and abnormal color of skin with these neologisms, definitions, and classifications with ease and clarity once the specific abnormality causing the color abnormality has been determined histologically or by other tests (Table IV). However, it is likely when initially evaluating a patient, the clinician might not be certain about either the cause of a discoloration observed or the precise diagnosis. It is the recommendation of the PDA that precise diagnostic terms be avoided until the abnormality can be determined by various histological or other tests and/or a definitive diagnosis can be made. Thus a patient presenting with darkened skin color should be classified with the clinical descriptive term as having a 3-cm brown macule. When the histological analyses are complete, the disorder can be more accurately described as a hyperpigmentation or a nonmelanotic hyperchromia. Likewise, skin with an abnormally white (light) color should be described as a 3-cm hypochromic or leukodermic macule. The

Table V. Some essential definitions

Achromia	A type of leukoderma; totally white skin from any cause
Amelanocytosis	Total absence of all melanocytes in the epidermis that will result in amelanosis
Depigmentation (amelanosis)	A type of leukoderma, also called amelanosis, caused by total absence of melanin in the epidermis from any cause
Dermatomal	Following the distribution of a cutaneous sensory nerve
Hyperchromia	Skin color that is darker than normal from any cause
Hypermelanocytosis	A higher than normal population density of melanocytes in the skin, either in the epidermis, the dermis, or both, resulting typically in hypermelanosis
Hypermelanosis	A type of hyperchromia that results from increased melanin in the skin, either epidermis, dermis, or both
Hypochromia	A type of leukoderma; skin color that is lighter than normal from any cause
Hypomelanocytosis	A lower than normal population density of melanocytes in the epidermis, typically resulting in hypomelanosis
Hypomelanosis	A type of leukoderma caused by a decreased melanin in the epidermis
Hypopigmentation (hypomelanosis)	A type of leukoderma caused by partial absence of melanin in the epidermis
Leukoderma	Skin with a white discoloration from any cause or by any mechanism
Pigmentary system	All melanocytes and their product melanin at all sites within the body
Pigmentation	Of, or pertaining to, melanocytes or melanin
Segmental	One portion of the integument, usually unilateral
Skin color	The color of the skin is determined by two distinct groups of chromophores (cells, structural agents, chemicals that impart color to the skin), those of the pigmentary system (ie, melanin and melanocytes) and those composed of other elements (chromatics) of the skin (eg, collagen, blood, carotenes)

pursuit of an accurate diagnosis is bolstered by the use of “neutral” descriptive terminology, rather than words that imply origin, before the precise diagnosis is known.

Some essential definitions using newly defined words are necessary (Table V). It is our hope that these words, definitions, and categories become the standard for all those teaching or writing books or articles or for all dermatologists as they discuss disorders of skin color. And we hope they will be incorporated into the dermatological lexicon currently under development.¹

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