Disclosure and Conflict of Interests

► None to declare

Skin pigmentation, race and ethnicity implications for biomedical research

HEATHER L. NORTON

ASSOCIATE PROFESSOR OF ANTHROPOLOGY

UNIVERSITY OF CINCINNATI

Objectives

Review methods for characterizing pigmentation

- Categorial
- Quantitative
- How does skin pigmentation correspond to socially constructed racial and ethnic categories?
- What happens when race, ethnicity and skin color are conflated?

Methods for Characterizing Skin Pigmentation -- Categorical

- Fitzpatrick Skin Phototype System
 - Developed as a measure of photosensitivity
 - Divided people into four categories based on skin response to UVA radiation
 - In 1988, two additional categories added
 - Darker skin colors (non-white patients)

TABLE 1	Fitzpatrick skin phototype (FSPT) categories
FSPT	

skin type	Erythema and tanning reaction
Ι	Always burns, never tans
II	Usually burns, tans with difficulty
III	Sometimes sustains a mild burn, average tanning capability
IV	Rarely burns, tans more than average (easily)

Note: Modified from Fitzpatrick (1988) and Eilers et al. (2013).

Methods for Characterizing Skin Pigmentation -- Categorical

Fitzpatrick Skin Phototyping

Benefits	Drawbacks
Requires no special measurement equipment	Insensitive to variation in darker skin colors
Can be assessed by dermatologist, trained evaluators, or via self-assessment	Clinically, Fitzpatrick categories are often conflated with race / ethnicity and skin pigmentation (Ware et al. 2020)

Methods for Characterizing Skin Pigmentation -- Quantitative

- Skin reflectometry
 - Melanin Index
 - Capitalizes on different absorbance and reflectance spectra of hemoglobin and melanin
 - Higher the Melanin Index, the darker the skin color
 - CIELab system
 - Any color described in three components
 - ► L*: light/dark
 - ▶ a*:red/green
 - ▶ b*: blue/yellow



Methods for Characterizing Skin Pigmentation -- Quantitative

Skin reflectometry

Individual Typology Angle (ITA)

$$\alpha = \tan^{-1}(\frac{L^* - 50}{b^*})$$

ITA classification	ITA range
Verylight	ITA° > 55
Light	41 < ITA° < 55
Intermediate	28 < ITA° < 41
Tan	10 < ITA° < 28
Brown	-30 < ITA° < 10
Dark	ITA° < -30

ITA classification scheme from Chardon et al. 1991

Methods for Characterizing Skin Pigmentation -- Quantitative

Skin Reflectometry

Benefits	Drawbacks
Objective assessment	Requires special equipment (\$)
Comparable across studies	Requires direct contact with research participant
Quantitative	
Sensitive to small to moderate variation in skin color	

How to translate numeric values to downstream users?

How do skin pigmentation assessments map on to racial or ethnic categories?

- Fitzpatrick Skin Phototype
 - Originally a measure of photosensitivity
 - Not intended as proxy for race or ethnicity, but often used this way
 - 31% of clinicians use FSPT to describe patient's ethnicity, 47% to describe skin color, and 22% to describe both (Ware et al. 2020)



How do skin pigmentation assessments map on to racial or ethnic categories?

- Fitzpatrick Skin Phototype
 - Originally a measure of photosensitivity
 - Not intended as proxy for race or ethnicity, but often used this way
 - 31% of clinicians use FSPT to describe patient's ethnicity, 47% to describe skin color, and 22% to describe both (Ware et al. 2020)
 - FSPT performs poorly in assessing photosensitivity in non-white populations



Distribution of M index Values Across Populations



Population (N)	Mean M Index (SD)
South Asian (315)	47.5 (6.1)
Mexican (101)	49.0 (4.2)
Island Melanesian (1135)	73.2 (10.8)
Hispanic (59)	39.2 (5.0)
European (799)	36.1 (3.6)
East Asian (429)	37.9 (3.0)
African American (160)	63.6 (12.6)

Data collected by H.L. Norton and collaborators (2000-2017) (references found on final slide)

How do skin pigmentation assessments map on to racial or ethnic categories?

NOT PARTICULARLY WELL

What happens when race, ethnicity, and skin color are conflated?

- Racialization of photosensitivity
 - Promotes misconception that all members identifying with a particularly racial or ethnic group are similarly photosensitive
 - Implications for skin cancer education and prevention, concerns about Vitamin D status



What happens when race, ethnicity, and skin color are conflated?

- Racialized melanocytes
 - "African" melanocytes vs. "European" or "Asian" melanocytes
 - But these social labels are not really describing what we are interested in...
 - ► Melanin content!
 - ▶ Better options—"darker", "lighter", etc.





Brenner M and Hearing VJ. 2008. The Protective Role of Melanin Against UV Damage in Human Skin. Photochemistry & Photobiology. **84:**539-549.

What happens when race, ethnicity, and skin color are conflated?

- Assessing the accuracy of pulse oximetry across skin colors
 - Investigations test accuracy across different racial and ethnic groups, but do not measure skin pigmentation
 - Consider heterogeneity in African American, South Asian samples
 - If sample primarily consists of individuals with lower M index values study is not sufficiently powered to detect possible bias

Anaesthesia 2022, 77, 143-152

doi:10.1111/anae.15581

Original Article

The effect of patient ethnicity on the accuracy of peripheral pulse oximetry in patients with COVID-19 pneumonitis: a single-centre, retrospective analysis

M. D. Wiles,^{1,2} A. El-Nayal,³ G. Elton,⁴ M. Malaj,³ J. Winterbottom,⁴ C. Gillies,⁵ I. K. Moppett⁶ and K. Bauchmuller¹

The NEW ENGLAND JOURNAL of MEDICINE

CORRESPONDENCE



Racial Bias in Pulse Oximetry Measurement

Sjoding et al. 2022 NEJM 383:25

Conclusions

Several different methods to assess skin color

Benefits of quantitative methods outweigh costs

- Skin pigmentation can show considerable overlap between socially constructed racial and ethnic groups
- There can also be a wide range of variation in skin pigmentation within such groups
- If skin pigmentation is the biologically relevant variable in a research investigation, then measure skin color.

Do not use race or ethnicity as a proxy

References

- Brenner M and Hearing VJ. 2008. The Protective Role of Melanin Against UV Damage in Human Skin. Photochemistry & Photobiology. 84:539-549.
- Chardon A, Cretois I, and Hourseau C. 1991. Skin color typology and suntanning pathways. International Journal of Cosmetic Science. 13:191-208.
- Fitzpatrick, T. (1988). The Validity and Practicality of Sun-Reactive Skin Types | Through VI. Archives of Dermatology, 124, 869–871.
- Pichon, L., Landrine, H., Corral, I., Hao, Y., Mayer, J., & Hoerster, K. (2010). Measuring skin cancer risk in African Americans: Is the Fitzpatrick Skin Type Classification Scale Culturally Sensitive? Ethnicity & Disease, 20, 174–179.
- Norton, H. L., Edwards, M., Krithika, S., Johnson, M., Werren, E., & Parra, E. (2016). Quantitative assessment of skin, hair, and iris variation in a diverse sample of individuals and associated genetic variation. American Journal of Physical Anthropology, 160(4), 570–581.
- Norton, H.L. (2021). The color of normal: How a Eurocentric focus erases pigmentation complexity. Human Biology **33**
- Robinson, J. K., Penedo, F. J., Hay, J. L., & Jablonski, N. G. (2017). Recognizing Latinos' range of skin pigment and phototypes to enhance skin cancer prevention. Pigment Cell & Melanoma Research, 30(5), 488–492
- Sjoding MW, Dickson RP, Iwashyna TJ, Gay SE, Valley TS. Racial Bias in Pulse Oximetry Measurement. New England Journal of Medicine 383:25.
- Wiles MD, El-Nayal A, Elton G et al. The effect of patient ethnicity on the accuracy of peripheral pulse oximetry in patients with COVID-10 pnuemonitis: a single-centre, retrospective analysis. Anaesthesia 77:143-152
- ▶ Ware, O. R., Dawson, J. E., Shinohara, M. M., & Taylor, S. C. (2020). Racial Limitations of Fitzpatrick Skin Type. SKIN OF COLOR, 105(77–80), 4.