ORIGINAL ARTICLE

Pigmentation in African American skin decreases with skin aging

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Background: Tristimulus colorimetry, which uses the Commission Internationale de l'Eclairage *L*a*b** model to quantify color, has previously been used to analyze pigmentation and erythema in human skin; however, colorimetry of African American skin is not well characterized.

Objective: We sought to analyze skin color patterns in African Americans and compare them with those of Caucasians.

Methods: Colorimetry readings of the sun-protected buttock and sun-exposed back of forearm were taken from 40 Caucasian and 43 African American participants from March 2011 through August 2015. African American participants also completed a lifestyle questionnaire. Correlation coefficients, paired *t* tests, and multivariable linear regression analyses were used for statistical comparisons.

Results: Forearm skin was lighter in African Americans ages 65 years and older versus 18 to 30 years (P = .02) but darker in Caucasians ages 65 years or older versus 18 to 30 years (P = .03). In African Americans ages 18 to 30 years, the buttock was darker than the forearm ($P < .001$), whereas in Caucasians the buttock was lighter than the forearm ($P < .001$). A lighter forearm than buttock was correlated with supplement use, smoking (ages 18-30 years), and less recreational sun exposure (ages ≥65 years) in African Americans.

Limitations: Our study was limited by the sample size and focal geographic source.

Conclusions: Pigmentation patterns regarding sun-protected and sun-exposed areas in African Americans may differ from that of Caucasians, suggesting that other factors may contribute to skin pigmentation in African Americans. (J Am Acad Dermatol http://dx.doi.org/10.1016/j.jaad.2016.05.007.)

Key words: African Americans; aging; Caucasians; colorimetry; ethnic skin; sun-exposed skin; sun-protected skin.

Tristimulus colorimetry, which uses the Commission Internationale de l'Eclairage *L*a*b** model to quantify color, has been used reliably to analyze human skin.[1-4] Its probe sends out white LED light in a range of emitted wavelengths of 440 to 670 nm, arranged circularly to uniformly illuminate the skin. The emitted light is scattered in all directions, with some light traveling through the layers of the skin and some light scattered out of the skin. The light reflected from the skin is measured in the probe, corrected with a special color matrix to adapt closely to standard

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This publication was made possible in part by the Johns Hopkins Institute for Clinical and Translational Research (ICTR), which is funded in part by Grant Number TL1 TR001078 from the National Center for Advancing Translational Sciences (NCATS), a component of the National Institutes of Health (NIH), and NIH Roadmap for Medical Research. Its contents are solely the responsibility of the authors and do not necessarily represent the official view of the Johns Hopkins ICTR, NCATS, or NIH.

Conflicts of interest: None declared.
Accepted for publication May 1, 2016.

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Published online June 16, 2016.
0190-9622/$36.00

http://dx.doi.org/10.1016/j.jaad.2016.05.007

values, and collected for a tristimulus color analysis, using the $L^*a^*b^*$ color system, as determined by the Commission Internationale de l'Eclairage. L^* gives information about the black-white axis, ranging from total black ($L^* = 0$) to total white ($L^* = +100$). The a^* value represents the balance between red ($a^* = +100$) and green ($a^* = -100$). The b^* value represents the balance between yellow ($b^* = +100$) and blue ($b^* = -100$).[1,2]

In Caucasians and East Asians, L^* (0 = black, 100 = white) has been used as a measure of pigmentation and a^* as a measure of red color component.[1-3] In these populations, previous studies suggest that sun-exposed skin sites darken with age, are darker than sun-protected skin sites, and show more redness than sun-protected skin sites.[3,4] However, there are limited published colorimetry data on African American skin. Our study offers a cross-sectional analysis of skin color patterns and associated lifestyle factors in African Americans according to age and skin site and compares these results with Caucasians.

CAPSULE SUMMARY

- In Caucasians, sun-exposed skin darkens with age and is darker than sun-protected skin.
- In African Americans, sun-exposed skin lightens with age and is lighter than sun-protected skin.
- Differential patterns of pigmentation and factors influencing pigmentation between Caucasians and African Americans may help identify targets for treatment of pigment disorders.

METHODS

Study participants, recruited through flyers and the dermatology clinics at the Johns Hopkins University Hospitals in Baltimore, MD, between March 2011 and August 2015, were stratified into 4 groups at study enrollment, with at least 20 patients in each group, based on ethnicity and age: Caucasians ages 18 to 30 years, Caucasians ages 65 years and over, African Americans ages 18 to 30 years, and African Americans ages 65 years and over. The selected age groups were chosen for comparability with previous literature.[4] Patients who self-identified as Caucasian or white and had a Fitzpatrick phototype of I, II, or III were defined as Caucasian in our study. Patients who self-identified as African American or black and had a Fitzpatrick phototype of V or VI were defined as African American in our study. We obtained colorimetry readings from study participants using a Konica Minolta CR-400 Chroma Meter (Konica Minolta Sensing Americas, Inc, Ramsey, NJ) of buttock (sun-protected site) and back of forearm (sun-exposed site) skin. Before use, the calibration channel of the colorimeter was brought to standard white-plate level.[4]

A questionnaire on demographics and lifestyle factors was administered to all African American participants to look for correlations between lifestyle and colorimeter values. Caucasian patients were used strictly as control subjects for colorimetry and thus did not complete the questionnaire. Using a REDCap database,[5] we collected data including demographic variables (age, gender), body mass index, significant weight loss, average daily sun exposure, duration of occupational sun exposure, frequency and duration of recreational sun exposure, intensity and duration of tobacco smoking, health supplement use, number of pregnancies, and duration of estrogen therapy/contraceptive pills.

We compared measurements between buttock and forearm sites using paired t tests, and between age groups (18-30 vs ≥65 years) using linear regression adjusting for age. Assumptions of the colorimetry data distribution were appropriately verified. Correlations between L^* and a^* values were estimated using Pearson r correlation coefficients. Differences in colorimeter values (ΔL^* and Δa^*) were calculated by subtracting the buttock measurement from the forearm measurement for each participant, and correlations of questionnaire variables with ΔL^* and Δa^* values were estimated using Spearman ρ correlation coefficients. Statistical analysis was conducted using software (Stata 14.0, StataCorp, College Station, TX).

RESULTS

We recruited 40 Caucasian and 43 African American into the 4 enrollment groups, for which gender and age distributions are reported (Table I). Among Caucasians ages 18 to 30 years, 25% were male, whereas among Caucasians ages 65 years and older, 70% were male. Among African Americans ages 18 to 30 years, 50% were male, versus 33.3% among African Americans ages 65 years and older.

Colorimetry in Caucasian patients

Among all Caucasians, the back of forearm was darker ($P < .001$) and presented with a greater red color component ($P < .001$) than the buttock (Table II). Findings remained similar after subgroup analyses among Caucasians aged 18 to 30 years and those 65 years and older. The back of forearm was