Evaluation of Inherent Differences Between African American and White Skin Surface Properties Using Subjective and Objective Measures

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Conflicting data have been published on the inherent differences in skin surface properties among various ethnic groups, though there is a widespread perception that differences exist. This study included subjective and objective assessments of skin surface properties in African American and white subjects. A dermatologist conducted visual assessments of photodamage and irritation. Instrumentation was employed to perform objective measurements of skin surface sebum level, pH, moisture content, and barrier function. In addition, resistance of skin to chemical challenge as a measure of barrier integrity was assessed in a subset of the populations. Results showed differences in photodamage and hyperpigmentation between the 2 ethnic groups tested, but no significant differences between the 2 groups were seen in the results of instrumental measurements for sebum, pH, corneometry (skin moisture), or transepidermal water loss (barrier function). These data help fill the gap in knowledge about photoaging-related differences in the skin of various ethnic groups, especially in textural and pigmentation parameters, as well as increase the knowledge base of differences in objective measures.

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There is a general perception that skin in various ethnic groups possesses different physical and biological properties that may affect sebum production, moisturization requirements, barrier function, responsiveness to topical agents, and chemical sensitivities, among others. A few studies have produced varying results in objective measures such as differences in transepidermal water loss (TEWL) and moisture content between ethnic groups.[1] Although the scientific data both support and dispute the hypothesis that skin of certain ethnic origins is somehow physiologically different from the skin of other ethnic groups, many physicians and consumers believe a difference exists. This belief may be in part due to marketing efforts for products designed to meet the perceived needs of specific ethnic groups. One area that has seen tremendous market growth in the last decade is the antiaging skin care market. Although only a few studies have compared the skin in ethnic groups for objective measures,[1-3] even fewer have reported data on inherent differences in textural and photoaging-related parameters.

The present study was conducted to gain some understanding of the inherent differences, both

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objective and subjective, between African American and white skin.

Methods

Study Population—Healthy women between the ages of 35 and 65 years were eligible for study participation. Subjects were recruited from 2 ethnic groups, African American and white, and all exhibited moderate photodamage on the face, as assessed by a 5-point severity scale.

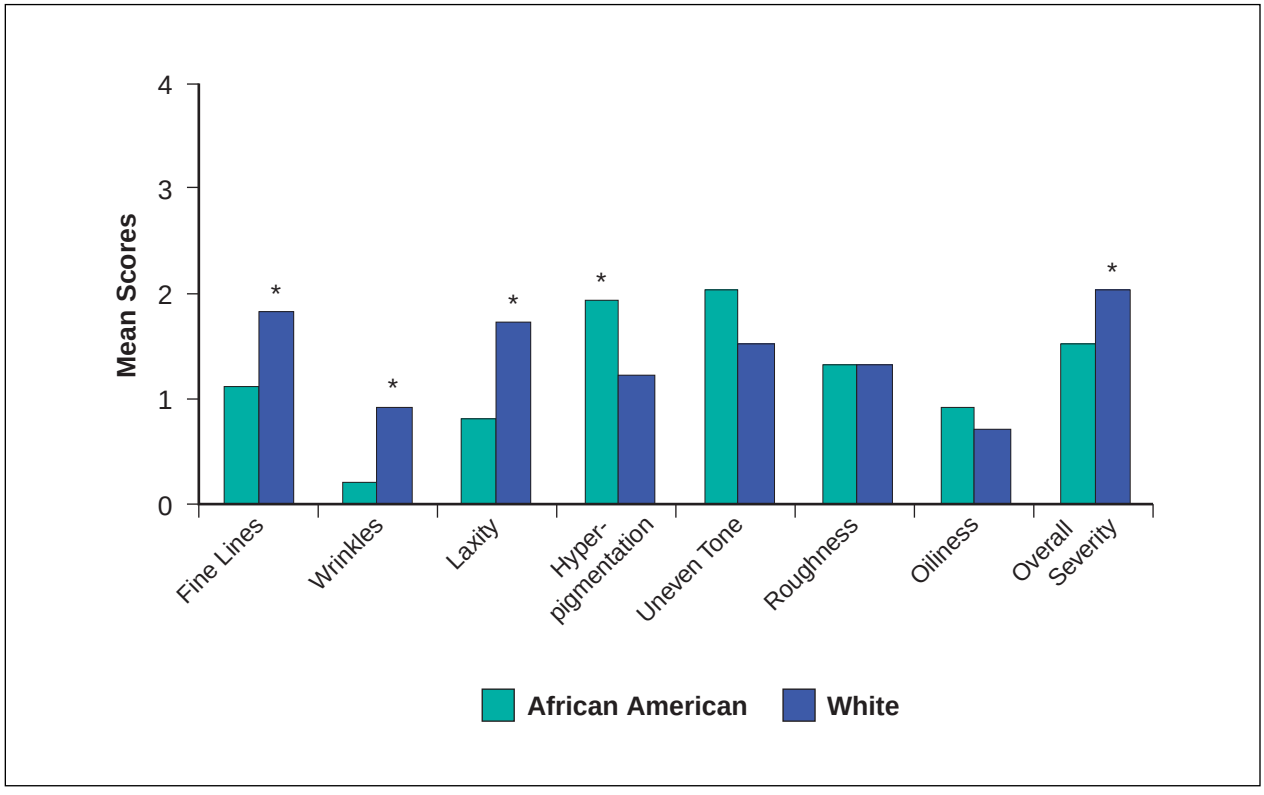
Subjects were required to refrain from using any topical products on the test sites (face and forearms) for 2 days prior to the start of the study. Use of their normal cleansers and nonmedicated makeup was permitted.

Evaluations—Following the 2-day washout period, baseline assessments were conducted by the dermatologist for evidence of photodamage, including fine lines, wrinkles, laxity, hyperpigmentation, uneven skin tone, and roughness, as well as overall severity of the condition. In addition, the dermatologist assessed oiliness and objective signs of irritation, including erythema, dryness, inflammation, and overall irritation. Subjective burning/stinging and itching were self-assessed by the study participants. All assessments used a 5-point scale (none, mild, moderate, marked, severe).

Data from noninvasive instrumental measurements also were collected. Subjects were required to allow their skin to equilibrate to room temperature and conditions for at least 15 minutes prior to the instrumental measurements. Sebum, pH, moisture content, and barrier function were measured using Courage-Khazaka instruments.

Skin surface sebum level was measured at the midline of the forehead using the Sebumeter® SM 810. Skin pH was measured directly above the left eyebrow using the Skin-pH-Meter® PH 900. For both of these assessments, the mean of 2 adjacent measurements was calculated. Skin moisture on the inner forearm was assessed with the Corneometer® CM 820, and the final value expressed as the mean of 3 readings. Barrier function also was assessed by measuring TEWL on the inner forearm. A single measurement was taken with the Tewameter® TM 210.

Finally, an assessment of barrier integrity was conducted using chemical challenge. A small subset from each ethnic group completed this portion of the study. A 5% aqueous solution of sodium lauryl



Dermatologist visual assessment of photoaging parameters. Asterisk indicates significantly more severe condition ($P \leq .05$). Mean scores are based on a 5-point scale: 0=none, 1=mild, 2=moderate, 3=marked, 4=severe.

Table 1.

Baseline Assessments by Ethnic Group*†

Assessment	African American n=18	White n=19
Sebum (face), μg/cm^2	158.9	164.0
pH (face)	5.7	6.0
Erythema (arms)	0	0
Moisture (forearm), a.u.	31.6	32.8
TEWL (forearm), g/hm^2	7.9	7.8

*TEWL indicates transepidermal water loss.
†No significant differences between the ethnic groups were observed, $P>.05$.

Table 2.

Transepidermal Water Loss and Sodium Lauryl Sulfate Challenge in African American and White Skin*

Assessment	African American n=3	White n=5
Baseline TEWL of SLS challenge subset, g/hm^2	9.1	8.7
After SLS challenge		
time=30 min	21.9	32.3
time=24 h	13.6	14.0
time=48 h	12.9	12.9

*TEWL indicates transepidermal water loss; SLS, sodium lauryl sulfate.

sulfate was applied to the inner forearm under occlusion (Hill Top Chamber®) for 6 hours. Assessment of TEWL was conducted at 30 minutes and 24 and 48 hours after patch removal.

Statistical Analysis—Comparisons for each parameter were made between the 2 ethnic groups using analysis of variance with pair-wise comparisons (Fisher least significant difference) to determine if significant differences existed. Significance was determined at the 95% confidence interval, $P\leq.05$.

Results from the chemical challenge were not statistically analyzed because of the small population sizes.

Results

A total of 37 subjects were evaluated, 18 African American subjects and 19 white subjects. A subset of 8 total subjects participated in the chemical challenge portion of the study.

Results of the visual photoaging assessments showed that white skin exhibited significantly more severe fine lines, wrinkles, laxity, and overall photodamage compared with African American skin. The data also showed that the skin in the African American subjects had more severe pigmentation-related problems, exhibiting significantly greater hyperpigmentation and a trend toward greater severity of uneven skin tone (Figure).

Results of the visual assessment by the dermatologist for irritation on the face indicated that white skin was significantly more erythematous than African American skin. There were no differences observed between the ethnic groups in any of the other objective or subjective irritation parameters assessed (dryness, inflammation, overall irritation, burning/stinging, and itching).

Results of the instrumental evaluations were similar in both ethnic groups (Table 1). There were no significant differences in the amount of sebum or skin pH measured on the face, nor were there significant differences in skin moisture or TEWL (barrier function) measured on the inner forearm.

Of the 8 subjects who participated in the chemical challenge portion of the study, 3 were African American and 5 were white (Table 2). An occlusive patch of 5% sodium lauryl sulfate was applied for 6 hours. After its removal, an immediate increase in TEWL was noted in white skin. After 24 hours, however, the initial increase was not evident, and the TEWL was found to be similar to that seen in African American skin. Results of this chemical challenge were not subjected to statistical analysis because of the small population sizes.

Comment

In this comparison of African American and white skin, significant differences were observed primarily in texture and pigmentation. Lighter skin had more severe fine lines, wrinkles, laxity, and overall photodamage, whereas darker skin showed more hyperpigmentation and uneven skin tone.

Previous studies measuring textural changes by means of skin elasticity have shown conflicting results that varied by anatomic site.[1-3] Elastic recovery, as measured on the cheeks, was greater in African American skin than in white skin.[2] This finding supports the results of the visual assessment in the current study. It is not surprising to physicians with experience in photodamage or ethnic skin that textural parameters such as fine lines, wrinkles, laxity, and overall photodamage are more apparent in lighter skin.[4] Fair skin is highly susceptible to the damaging effects of UV radiation,[5] as seen by its increased propensity to burn. Thus, it seems reasonable to attribute this increase in textural properties to sun damage due to decreased inherent melanin content. Indeed, a number of differences between sun-exposed and non–sun-exposed skin have been reported for various ethnic groups.[3]

Another difference supported by the present findings is the prevalence of hyperpigmentation and uneven skin tone in African American skin.[4,6] Postinflammatory hyperpigmentation is a well-known concern in this population.[7] The uneven pigmentation may be more prevalent in African American skin than in white skin, or perhaps it is just more apparent. Light reflectance or optical properties of darker skin tones may accentuate this problem, making it more prominent. Further investigation into the underlying causes of pigmentation problems in this population is warranted.

The desire to minimize the appearance of textural and pigmentation problems has prompted a number of technologic advances. The use of topical products has increased, as have the number of visits to dermatologists for in-office procedures. The recent boom in treatment for these problems is reflected in a generalized increase in the use of α-hydroxyacids and polyhydroxy acids and improvements in laser technology to meet the needs of many skin types and conditions. Each therapy has its use in a physician's office and has proven benefits to skin in general,[8-11] including skin smoothing and skin tone improvement in several ethnic groups.[12,13] The results of visual assessment in the current study demonstrated the inherent aging-related differences between the 2 ethnic groups and highlighted areas in need of concentration for each group.

In this study, results of some of the visual assessments suggested inherent skin surface differences between the 2 ethnic groups, but the instrumental measures found no significant differences in baseline skin surface parameters. No significant differences between African American and white skin were observed in sebum level or skin pH measured on the forehead or in moisture content or barrier function evaluated on the inner forearm.

A few of these objective parameters have been assessed previously. For example, Warrier et al[2] showed that skin pH was lower in African American skin than in white skin when measured on the cheeks. Similar results were seen in the current study, although the differences did not reach statistical significance. Therefore, the results of the present study lend additional support to the hypothesis that some differences do exist between African American and white skin.

The Warrier et al[2] study also assessed barrier function in the skin of 30 African American and 30 white women. When measured on the cheeks and legs, barrier function was greater in African Americans, but when measured on the forearm, as in the current study, TEWL was not found to be significantly different between the groups.[2] The findings of this study and the present one suggest variability in skin properties between not only ethnic groups but also anatomic sites.

A recent review of studies conducted to assess moisture content found wide variability in the data.[1] Several instruments are used to measure moisture content, each employing related but distinct principles; the differences between instruments make direct comparison of data difficult. In addition, difficulties have been reported with regard to interference with hair, residue from product application, sweat production, and other factors. In the current study, no difference between the ethnic groups was observed for moisture content as measured by capacitance. Additional investigation of the confounding influences should be considered to help determine definitive differences.

Few studies have included sebum measurements as a part of an assessment of inherent differences. Lipid content in the skin of different ethnic groups has been measured, but results have been conflicting.[1] Skin microflora or density of *Propionibacterium acnes* also has been investigated but to a limited degree.[1,2] No differences in skin surface sebum between the ethnic groups were observed in the current study.

The results from the chemical challenge suggested that white skin initially appeared to be more sensitive to sodium lauryl sulfate insult than African American skin. However, after a short time (24 hours), the TEWL level of white skin did recover to levels comparable with those of African American skin. It is difficult to draw concrete conclusions from these data, however, because of the small sample size. It would be of interest to investigate this skin assessment in a larger population.

The results of this study provide insight into the similarities and differences in skin surface parameters between African American and white ethnic groups. The outcome of these assessments also demonstrates the complexity of skin and the challenges involved in the use of noninvasive measurements. Numerous biologic functions underlie surface characteristics. Employing a multipronged approach and interpreting the various measurements with regard to each other are important to gain a better understanding of the skin processes of various ethnic groups.

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