Effect of Age, Gender, and Sun Exposure on Ethnic Skin Photoaging: Evidence Gathered Using a New Photonumeric Scale

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Abstract: Background: African–Americans are less affected by photoaging than lighter skin individuals. Although scales for photoaging have been developed for Caucasians and Asians, no scale exists for African–Americans.

Aim: To develop a photonumeric scale for photoaging and to determine factors that contribute to photoaging in African–Americans.

Methods: Five participants' photographs were selected as standards to create a 9-point photonumeric scale (0 = none, 8 = most severe). Three blinded dermatologists used the scale to grade the remaining participants' photographs.

Results: Interrater reliabilities were 0.775 (95% CI: 0.635, 0.880) for trial 1 and 0.832 (0.747, 0.883) for trial 2. Intrarater reliabilities, assessed over a 1 week interval, were 0.863 (0.727, 0.940), 0.928 (0.890, 0.954), and 0.866 (0.739, 0.935) for the three graders, indicating strong agreement. Photoaging scores were then correlated with participants' survey on lifestyle factors, which yielded age as a significant predictor ($r = 0.91$, $p < 0.001$). Furthermore, multiple regression model to predict facial photoaging (adjusted $R^2 = 0.849$) selected age ($b_1 = 0.111$, $p < 0.001$), sun exposure ($b_2 = 0.206$, $p = 0.014$), and gender ($b_2 = -0.388$, $p = 0.063$) as the most important variables.

Conclusions: A reliable photonumeric scale for photoaging in African Americans was developed. Age, sun exposure, and male gender were found to be contributory factors to photoaging.

Keywords: Ethnic skin■Aging■African Americans■Sun-exposed skin■Photoaging scale

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INTRODUCTION

Skin aging continues to be a topic of intense interest among the US population. By 2020, the global anti-aging products market is expected to reach $275 billion, with United States accounting for one of the largest markets worldwide.[1] Prevention and treatment of visible skin damage resulting from ultraviolet (UV) radiation and other external factors are common concerns among dermatology clinic patients.[2] Wide varieties of dermatological products and procedures are currently available to address these issues, and ongoing research will lead to the availability of new therapies.

The features of photoaging, or extrinsic cutaneous damage, are traditionally associated with skin atrophy, wrinkling, leathery skin, and lentigines. However, signs of aging are known to vary with skin phototype. Lighter-skinned patients have more atrophy and premalignant changes as well as more prominent fine wrinkling than darker-skinned patients, who have more pigmentation changes.[2,3] The differences in clinical features give rise to varying considerations in evaluation and management.

In investigating the efficacy of anti-aging interventions, objective assessments of photoaging are necessary. Photonumeric scales have been shown to be more effective than written, descriptive scales for the evaluation of extrinsic skin aging.[4] Such scales have been developed for Caucasians and Asians.[4,5] However, no similar scales have yet been developed for darker-skinned groups, including African–Americans. By 2050, non-Hispanic Caucasians are projected to no longer make up the majority of the US population.[6] It is important to ensure that skin of color is not overlooked in the literature.

With this objective in mind, we created a 9-point photonumeric scale consisting of five individuals' facial photographs, designed to assess the severity of photoaging specifically in the African–American population. The validity of this scale was tested by having three independent graders apply the scale to evaluate 70 participants' photoaging. The assigned scores were further correlated

with demographic and survey data to determine contributory factors in this population.

METHODS

Participant recruitment

Participants were screened and enrolled at the Johns Hopkins Outpatient Center, Baltimore, Maryland. The inclusion criteria included: African−American race and willingness to stop topical medication use on the face 2 weeks prior to study. Exclusion criteria included history of topical retinoid use within 1 year of enrollment or topical 5-fluorouracil use, history of facial surgeries or cosmetic procedures, significant or severe illness, pregnancy or breastfeeding status, and significant facial hair. All participants signed an informed consent form that was approved by the Johns Hopkins Institutional Review Board.

Photonumeric scale

Standardized photographs of each participant's face at rest (*en face* and 45° oblique) were taken using a stereotactic device in concert with a camera and a light source (Canfield Scientific, Fairfield, NJ). Among the participants, five were selected as grades 0, 2, 4, 6, and 8 to show progressive photoaging damage, where 0 is no damage and 8 is severe photodamage. The standards were chosen based on photoaging signs including nasolabial folds and marionette lines, in addition to fine and coarse wrinkles, skin laxity, and mottled pigmentation. The participants selected as standards were excluded from subsequent grading and analyses.

Three dermatologists graded participants' randomly ordered photographs using the scale. The evaluators were blinded to participant age, history, and survey responses. Intermediate scores of photoaging severity (1, 3, 5, or 7) were allowed. At least one week following trial 1, the order of participant photographs was re-randomized, and gradings were repeated by the same three dermatologists. The assigned grades were used to calculate inter- and intra-rater reliability scores as well as for correlation between photoaging and lifestyle factors.

Survey

Participants responded to a survey which included demographic questions about age, gender, weight, and height. Questions regarding lifestyle factors included daily sun exposure, sunscreen use, smoking duration, packs smoked per day, supplement use, nonsteroidal anti-inflammatory drug (NSAID) use, and, for women only, hormonal therapy and number of pregnancies leading to birth. Daily sun exposure was categorized as less than 30 min, 30 min to 2 h, 2−6 h, or 6 h or more. Sunscreen use was categorized as every day; most days; only before prolonged sun exposure, every time; only before prolonged sun exposure, sometimes; rarely or never. Smoking was categorized as less than 1 year, 1 to <5 years, 5 to <10 years, or over 10 years. Smoking quantity was categorized as less than 1 cigarette per day, quarter pack per day (1−5 cigarettes), half pack per day (5−10 cigarettes), or 1 pack a day or more. Health supplement use was noted as absent or present. NSAID use was noted as yes or no. Hormonal therapy included oral contraceptives, hormone replacement therapy, and other hormonal treatment. This variable was categorized as less than 1 year, 1−4 years, or 5 years or more. The number of pregnancies leading to actual birth was quantified as 1−2, 3−5, or 6 or more.

Statistical analysis

The inter- and intra-relater reliabilities of the photonumeric scale were assessed via the intraclass correlation coefficient (ICC) method. Descriptive statistics were generated for photoaging score, age, sex, body mass index (BMI), sun exposure, sunscreen use, smoking duration, smoking quantity, supplement use, NSAID use, hormonal therapy, and number of pregnancies. Photoaging scores from three graders across two trials were averaged to generate a final photoaging score for each participant. This score was used in analyses of correlation and multiple linear regression. Specifically, correlations between photoaging score and the following variables were evaluated: age, gender, BMI, sun exposure, sunscreen use, smoking duration, packs smoked per day, hormonal therapy, and pregnancies. The Pearson correlation method was used for all variables with the exception of gender, for which the Spearman correlation method was used. The forward selection linear regression method was employed to create a model for predicting the degree of photoaging. Data entry and analysis were performed using Excel (Microsoft, Redmond, WA) and R statistical software (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Seventy-five African−American participants aged 18 to 96 completed the study protocol, including 23 males and 52 females. Additional demographic and survey response data are illustrated in Table 1. Five participants were selected as standards for the photonumeric scale, such that 70 participants had their photographs graded using the scale (Figure 1A−J). Among the participants, the distribution of average photoaging scores as assigned by graders was the following: 27 (39%) in the 0 to <2 group, 20 (29%) in the 2 to <4 group, 16 (23%) in the 4 to <6 group, and 7 (10%) in the 6−8 group.

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