Sun Sensitivity in 5 US Ethnoracial Groups

Gabriel R. Galindo, MPH; Joni A. Mayer, PhD; Donald Slymen, PhD; Delshad D. Almaguer, MPH; Elizabeth Clapp, MPH; Latrice C. Pichon, MPH; Katherine Hoerster, MPH; John P. Elder, PhD

Some sun safety activities have included only non-Hispanic white individuals, even though individuals in other ethnoracial groups may be at risk for skin cancer. The objectives of this study were to investigate distributions of self-reported Fitzpatrick skin type within 5 ethnoracial groups and substantiate each group's self-report with an objective measure. The study used a cross-sectional design. The research was conducted at 70 postal stations in Southern California. Participants were US Postal Service letter carriers and included 115 Pacific Islanders, 222 black individuals, 329 Asians, 513 Hispanics, and 1364 non-Hispanic white individuals. Participants self-reported skin type and had skin color measurements taken with colorimeters. Some individuals in each ethnoracial group reported having sun-sensitive skin. Correlation tests assessing the relationship between skin type and colorimeter data showed substantial associations for each group except Asians. Future sun safety research and educational messages should include all potentially high-risk individuals, irrespective of ethnoracial identity.

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In the United States, rates of melanoma vary by ethnoracial group, and from 1998 to 2002, the age-adjusted incidence rates per 100,000 in men and women were 25.9 and 17.2, respectively, in white individuals; 4.5 and 4.4, respectively, in Hispanics; 1.8 and 1.6, respectively, in Asians/Pacific Islanders; and 1.3 and 0.8, respectively, in black individuals.[1] In a recent report of melanoma rates in California between 1988 and 2001, Hispanics showed substantial increases in invasive melanoma incidence. These increases were confined to thick tumors, in contrast to trends in the non-Hispanic white population.[2] Although black individuals have relatively low rates of melanoma, they have poorer survival rates than white individuals. Specifically, 5-year survival rates were approximately 76% for black men (versus 90% for white men) and 78% for black women (versus 94% for white women).[1] Population-based data for nonmelanoma skin cancers (NMSCs) in the United States are not routinely collected.

Sun sensitivity is a risk factor for both melanoma[3,4] and NMSC.[3,5,6] Although a variety of survey items have been used to assess sun sensitivity, the Fitzpatrick skin type classification,[7] which attempts to measure skin phototype (ie, propensity of skin to burn and tan), is one of the more often used measurement strategies. The scale initially had 4 categories and was developed primarily for use with white populations.[7] Subsequently, 2 categories were added. These categories were duplicates of type IV (ie, the least sun-sensitive type) but specified brown (type V) or black (type VI) skin color.[7]

Categorizing all individuals with darker skin, or all individuals who belong to ethnoracial groups typically associated with darker skin, as having low sun sensitivity, though a prevalent tendency among both professionals and laypeople, may be based on erroneous assumptions.[8] Therefore, excluding these individuals from skin cancer prevention research and practice is questionable. The purpose of this study was to describe the distribution of self-reported skin type within each of the 5 ethnoracial groups studied and attempt to verify the accuracy

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From the Graduate School of Public Health, San Diego State University, California.
The authors report no conflict of interest.
Reprints: Joni A. Mayer, PhD, Graduate School of Public Health, San Diego State University, 5500 Campanile Dr, Hardy Tower #119, San Diego, CA 92182-4162 (e-mail: jmayer@mail.sdsu.edu).

of this self-report within each of the 5 ethnoracial groups using a colorimeter.

Methods

Study Design—Project SUNWISE was a 2-group, randomized, controlled sun safety intervention trial among outdoor US Postal Service letter carriers. Seventy postal stations in California participated (53 from San Diego County, 11 from Riverside County [nondesert and San Bernardino County], and 6 from Riverside County [desert]); postal station was the unit of randomization. The overall purpose of Project SUNWISE was to increase the sun safety practices (ie, hat use and sunscreen application) among participants. Data collection occurred at baseline (June to August 2001) and at 3-, 12-, 24-, and 36-month follow-ups. Baseline data (the basis for our findings) were collected prior to revealing the study condition of each postal station. All procedures for the study were approved by the institutional review board at San Diego State University.

Measurement Procedures—Using a 43-item paper-and-pencil survey, we measured self-reported recent sun safety practices, skin cancer risk information, and demographic characteristics; this instrument has been previously described.[9-12] Of particular importance in this analysis were the survey items on skin type and self-identified ethnoracial identity. Using the Fitzpatrick skin type classification,[7] subjects self-reported skin type based on the 4-category classification system. Subjects were asked the following question: which of the following best describes your skin's usual reaction to your first exposure to summer sun, without sunscreen, for one-half hour at midday? Subjects selected one of the following responses corresponding with a specific Fitzpatrick skin type: always burn, unable to tan (type I); usually burn, then can tan if I work at it (type II); sometimes mild burn, then tan easily (type III); rarely burn, tan easily (type IV). Response categories for ethnoracial identity included non-Hispanic white, Hispanic, African American or black, Asian, Pacific Islander, American Indian or Native American, and Other. Participants were instructed to endorse the category that best described themselves.

Skin color was assessed by trained data collectors with colorimeters, usually on the same day the survey was administered. For the current analysis, the L* color dimension was used (possible range of scores, 0–100). This dimension measures black to white, with higher scores indicating lighter color. Three sites on each participant's face were measured twice by the primary data collector: right cheek, left cheek, and forehead. Approximately every third participant was independently measured by a second data collector. A face score for L* was computed and used in the analysis. To compute this score, we first averaged the 2 values obtained by the data collector for each facial site. The mean L* scores for the right and left cheek were then averaged, forming the composite L* cheek score. Finally, the mean of the composite L* cheek score and the forehead L* score were averaged to form the L* face score. (L* scores for each of the 3 sites were highly intercorrelated.)

Statistical Analysis—Descriptive statistics were generated for the distribution of skin type, by ethnoracial group, and for the mean L* face scores, by ethnoracial group and skin type. Within each ethnoracial group, the bivariate association between skin type and L* face colorimeter score was explored using the Pearson product moment correlation. Generalized estimating equations (GEE) were used to determine if the relationship between skin type and L* face score varied by ethnoracial group. A model was constructed with L* face score as the dependent variable and skin type, ethnoracial group, and the interaction between skin type and ethnoracial group as the independent variables. Clustering of observations within postal stations was accounted for and the empirical standard error estimates were used for all inferences.

Results

Participants—Of the 4187 letter carriers who were invited to participate in the study, 2868 (68.5%) letter carriers consented. Of these participants, 2662 completed a baseline survey. The low number of American Indians resulted in their exclusion from data analysis. Likewise, those who identified as Other were excluded because their data would have been difficult to interpret. Of the 2543 participants in the remaining 5 ethnoracial groups, 2533 provided self-reported skin type data, upon which the skin type distributions we report were based. Complete data for both skin type and colorimeter readings were available for 2413 of these participants. Interrater reliability data for the colorimeter readings were obtained for a subsample of 701 participants. More detailed information about recruitment procedures, the flow of participants, and demographics have been reported elsewhere.[10] Briefly, participants had a mean age of 43 years (SD=8.54), had worked an average of 12 years as a letter carrier (SD=7.83), and spent an average of 4 hours per workday outdoors (SD=1.9). The majority of participants (68%) were men.

Skin Type Distribution—Table 1 shows the distribution of the 4 skin types within each ethnoracial group.

Colorimeter Data and Validation of Self-reported Skin Type—Interrater reliability data using the

Table 1.

Skin Type Distribution by Ethnoracial Group (N=2533)*

Ethnoracial Group	Fitzpatrick Skin Type† I	II	III	IV
Non-Hispanic white, % (n=1362)	7.6	26.7	41.5	24.2
Hispanic, % (n=513)	3.3	10.7	31.8	54.2
Asian, % (n=325)	4.3	8.6	32.3	54.8
Black, % (n=219)	2.7	2.7	11.9	82.6
Pacific Islander, % (n=114)	0.8	3.5	32.5	63.2

*Excludes participants who self-identified as American Indian or Other, did not complete a baseline survey, or had missing data on the race/ethnicity or skin type items.

†Survey responses corresponded with Fitzpatrick skin types: always burn, unable to tan (type I); usually burn, then can tan if I work at it (type II); sometimes mild burn, then tan easily (type III); rarely burn, tan easily (type IV).

Pearson product moment correlation for the colorimeter L* values (n=701) for each of the 3 facial sites were high: r=0.98, P<.01 for right cheek; r=0.98, P<.01 for left cheek; and r=0.96, P<.01 for forehead. The mean L* face scores, compiled from the raw data, with higher scores indicating "whiter" skin color, were 58.5 (SD=3.5) for non-Hispanic white individuals, 55.7 (SD=3.9) for Hispanics, 53.9 (SD=3.8) for Asians, 44.1 (SD=6.3) for black individuals, and 53.0 (SD=3.2) for Pacific Islanders. Table 2 shows the mean L* face scores for each ethnoracial group by skin type. Although trends are apparent for non-Hispanic white individuals and Hispanics, it is difficult to discern trends for black individuals or Pacific Islanders without further analytic evaluation due to the small sample sizes.

Table 3 presents the results for the Pearson product moment correlation tests and the GEE. In the GEE, within every ethnoracial group except Asians, skin type and L* face scores were significantly correlated in the predicted direction (P<.0001, non-Hispanic white individuals and Hispanics; P=.65, Asians; P=.0178, black individuals; P=.0035, Pacific Islanders). Furthermore, the interaction term was statistically significant (P=.0068), indicating the relationship between skin type and L* face score did vary by ethnoracial group. Because there was no apriori decision about comparison of effects among ethnoracial groups, a Bonferroni adjustment was applied to account for multiple comparisons. Individual contrasts were fitted among the 5 ethnoracial groups, yielding 10 pairwise comparisons. The results indicated that Hispanics had a stronger skin type–L* relationship than Asians (P<.05, Bonferroni adjusted), and Pacific Islanders had a marginally significant stronger relationship than Asians (P=.086, Bonferroni adjusted). None of the other comparisons were significant.

Comment

In this study, some of the participants from ethnoracial groups typically thought to have low sun sensitivity reported Fitzpatrick skin types I or II. Thus, based on skin type alone, individuals in each of these groups may have a relatively high risk for melanoma and NMSC.[3-6] Because these individuals work outdoors in Southern California, they may be at a particularly high risk for squamous cell carcinoma[13,14] and possibly other forms of skin cancer.[15,16] We could find little previous data on self-reported skin type in various ethnoracial groups to compare with our data. The general finding in the existing studies was that Hispanics, black individuals, Native Americans, and Asians/Pacific Islanders showed moderate levels of heterogeneity in skin type and/or other measures of sun sensitivity, comparable with our study.[8,17-21]

Individuals who self-identify with groups other than non-Hispanic white individuals may erroneously perceive that their risk for skin cancer is negligible. This perception may reduce prevention and screening behaviors, which in turn may be causing the large increases in thick melanomas found in Hispanics[2] and the poor melanoma survival rates found in black individuals.[1] Pichon et al[12] previously reported that, relative to non-Hispanic white letter carriers, letter carriers in each of the other ethnoracial groups had lower rates of sunscreen use, even with skin type held constant.[12] Likewise, in

Table 2.

Mean L* Face Scores by Ethnoracial Group and Skin Type (N=2413)*

	Fitzpatrick Skin Type†			
Ethnoracial Group	**I**	**II**	**III**	**IV**
Non-Hispanic white				
Mean	60.16	59.18	58.39	57.54
SD	3.94	3.14	3.51	3.16
n	95	342	533	314
Hispanic				
Mean	59.61	56.79	56.31	55.00
SD	5.65	4.14	3.61	3.58
n	16	54	154	269
Asian				
Mean	52.16	54.38	54.51	53.64
SD	4.34	3.98	4.56	3.17
n	14	28	99	172
Black				
Mean	45.19	45.50	47.80	43.48
SD	6.98	9.13	5.26	6.17
n	6	6	26	174
Pacific Islander				
Mean	52.92	56.75	53.92	52.34
SD	0	3.27	3.08	2.98
n	1	4	37	69

*Excludes participants in these 5 ethnoracial groups for whom either skin type or colorimeter data were missing.

†Survey responses corresponded with Fitzpatrick skin types: always burn, unable to tan (type I); usually burn, then can tan if I work at it (type II); sometimes mild burn, then tan easily (type III); rarely burn, tan easily (type IV).

other studies reporting data on sun safety behaviors by ethnoracial group, Hispanic and black samples typically reported low absolute rates of these behaviors[18,20,22,23] and lower rates than non-Hispanic white individuals.[22,23] Relative to non-Hispanic white individuals, Hispanics[19,22] and black individuals[22] report lower rates of skin self-examination.

Our analysis also indicated that, with the exception of the Asian participants, self-report of skin type using the 4-category Fitzpatrick system was valid for each group when verified using colorimeter values. Moreover, the strength of these associations for Hispanics, black individuals, and Pacific Islanders did not differ statistically from the strength of the association found for non-Hispanic white individuals. We used the L* color dimension measured with a colorimeter for UV radiation–exposed body sites to attempt to validate self-report of skin type. Tristimulus colorimeters have been used in previous dermatologic studies and in a few sun safety intervention studies.[24,25] Takiwaki and colleagues[26] found a substantial correlation between the colorimeter L* and the melanin index of a narrowband reflectance spectrophotometer. This latter measure of melanin density has been found to be strongly correlated with melanin density obtained from skin biopsies.[27]

Table 3.

Associations Between Skin Type and L* Face Score*

Ethnoracial Group	n	Pearson Product Moment Correlation†	GEE Adjusted *P* Value
Non-Hispanic white	1284	−0.217	<.0001
Hispanic	493	−0.250	<.0001
Asian	313	−0.012	.65
Black	212	−0.152	.0178
Pacific Islander	111	−0.293	.0035

*GEE indicates generalized estimating equations.
†Tests the null hypothesis that the correlation equals 0.

Among the few previous studies that compared self-reported skin type with skin reflectance, Rubegni and colleagues,[28] in a sample of white Italian subjects, used the difference in unexposed site (buttocks) versus exposed site (cheeks) for the 3 colorimeter dimensions to predict self-reported skin type. The L* difference value was the most consistent discriminator between each of the 4 skin types. Nevertheless, in their study, the mean L* for cheek alone showed a respectable difference between skin types I and IV.[28] In a sample of National Institutes of Health employees, correlations for self-reported skin type and spectrophotometer-measured melanin index for inner upper arms were 0.28 for white individuals, 0.29 for Hispanics, and 0.42 for black individuals; the correlation for only white individuals reached statistical significance ($P<.01$), likely due to small sample sizes and/or less variability in other groups.[8] Initially, we had additionally planned to use colorimeter data from an unexposed site—the inner upper arm. However, in our sample, consistent with another study,[29] this site proved to receive sun exposure, and consequently we decided to discard the data. Our decision to use the L* dimension rather than b* or a* was based on a combination of the Rubegni et al[28] findings and our sample's year-round sun exposure.

A limitation of this study is that we did not have a true unexposed body site to use along with the exposed site for verifying self-reported skin type; it was not possible in the particular work environment. Our use of the exposed (facial) site only may account for the relatively small associations for each ethnoracial group. Additionally, using spectrophotometer-measured melanin density to verify self-reported skin type may have been more desirable, given its relatively strong correlation with actual melanin density[27] and its ability to predict both melanoma and NMSC, at least in samples of white skin types.[30]

Some researchers have questioned the relevance of using the Fitzpatrick skin type classification with individuals with skin of color.[31,32] The present skin type distributions indicate that if all black individuals, Hispanics, and Pacific Islanders had been assumed to have type IV skin, an important proportion of them would have been misclassified.

Conclusion

Determination of skin cancer risk should be based on factors other than ethnoracial identity, including UV radiation exposure and sun sensitivity. Because skin cancer prevention and screening practices historically have been lower among Hispanics and black individuals, interventions that are tailored to each of these groups will be needed.

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