



## Correlates of sun protection behaviors in racially and ethnically diverse U.S. adults

Tirza Areli Calderón<sup>a,\*</sup>, Amy Bleakley<sup>b</sup>, Amy B. Jordan<sup>b,c</sup>, DeAnn Lazovich<sup>d</sup>, Karen Glanz<sup>a</sup>

<sup>a</sup> University of Pennsylvania Perelman School of Medicine, 423 Guardian Drive, Blockley Hall, Philadelphia, PA 19104, United States of America

<sup>b</sup> University of Pennsylvania Annenberg School for Communication, 3620 Walnut Street, Philadelphia, PA 19104, United States of America

<sup>c</sup> Rutgers University School of Communication and Information, 4 Huntington Street, New Brunswick, NJ 08901, United States of America

<sup>d</sup> University of Minnesota School of Public Health, 1300 South 2nd Street, Minneapolis, MN 55454, United States of America

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### ABSTRACT

Although skin cancer incidence is highest among non-Hispanic Whites, minority populations are often diagnosed with more advanced stage disease and are more likely to experience poor outcomes. Fewer people of color do not practice primary prevention of skin cancer according to recommendations, but public health education and interventions to promote sun protection behaviors have consistently targeted non-Hispanic Whites. This study examines performance of sun protection behaviors in a multiethnic sample and whether demographic, lifestyle and psychosocial predictors of these behaviors differ by race and ethnicity. In this study, a probability-based sample of 1742 adults completed an online survey in 2015. Main outcomes of interest included sunscreen use, wearing a sleeved shirt, and seeking shade. We stratified the sample into racial/ethnic groups (White, Black, Hispanic, Asian) and investigated demographic, lifestyle and psychosocial correlates of these behaviors in each group. Differences in adjusted estimates from each behavior-specific model were tested across strata. Racial/ethnic groups were significantly different in regards to sunscreen use and wearing a sleeved shirt, but similarly engaged in seeking shade. Results from multivariate ordered logistic regression models for each behavior revealed important demographic, lifestyle and psychosocial predictors and the importance of some demographic correlates varied between racial/ethnic groups. This study provides insight into the practice and correlates of skin cancer prevention among a multiethnic sample. Our findings suggest that targeting public health education efforts and interventions to promote sun protection in minority populations may be a beneficial approach to addressing heightened skin cancer morbidity and mortality in these groups.

### 1. Introduction

Skin cancer is the most common cancer diagnosed in the United States, affecting more than 3.5 million people (Holman et al., 2018; Agbai et al., 2014). Skin cancer incidence rates have increased dramatically in recent years and rates of melanoma and nonmelanoma skin cancer are highest among non-Hispanic Whites (Vital Signs: Melanoma Incidence and Mortality Trends and Projections — United States, 1982–2030 [Internet]). However, skin cancer has also increased among people of color and there is higher morbidity and mortality among these groups (Cockburn et al., 2006). People of color often present with atypical, more advanced disease and are more likely to experience poorer prognosis and outcomes than Whites (Holman et al., 2018; Bellows et al., 2001; Byrd et al., 2004; Hu et al., 2009; Wu et al., 2011; Dawes et al., 2016). Blacks and Hispanics are more likely to have delayed skin cancer diagnoses and lower survival rates (Agbai et al., 2014;

Cockburn et al., 2006; Byrd et al., 2004; Hu et al., 2009; Cormier et al., 2006).

Most skin cancers are preventable with consistent use of effective sun protection strategies, including application of broad-spectrum sunscreen, wearing protective clothing, seeking shade, and avoiding indoor tanning (American Cancer Society, 2018; van der Pols et al., 2006; Green et al., 2011; Lim et al., 2011). Nevertheless, sun protection behaviors are inadequately practiced (Buller et al., 2011; Coups et al., 2008). Studies have found that minority populations, particularly Hispanics and Blacks, do not use recommended skin cancer prevention strategies routinely (Coups et al., 2008; Coups et al., 2012; Coups et al., 2013; Weiss et al., 2012; Andreeva et al., 2009). People of color tend to be less knowledgeable about skin cancer risks and prevention compared to non-Hispanic Whites, which may contribute to poor adherence to prevention strategies (Ma et al., 2007; Pipitone et al., 2002). Additionally, public health education efforts and interventions to promote

\* Corresponding author

E-mail address: [tirzac@penmedicine.upenn.edu](mailto:tirzac@penmedicine.upenn.edu) (T.A. Calderón).

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sun protection behaviors focus mainly on non-Hispanic White populations.

Existing studies largely focus on demographic factors associated with sun protection behaviors (Coups et al., 2012; Coups et al., 2013; Andreeva et al., 2009). While these factors are important, an understanding of how lifestyle and psychosocial factors relate to sun protection is critical for development of skin cancer prevention programming. We present an investigation of demographic, lifestyle and psychosocial factors associated with three sun protection behaviors (suntan use, wearing a sleeved shirt and seeking shade) across four racial/ethnic groups: White, Black, Hispanic and Asian. This study examined whether racial/ethnic groups differ in their performance of sun protection behaviors and whether demographic, lifestyle and psychosocial predictors of these behaviors differ by race/ethnicity. Enhancing our understanding of sun protection behavior among minority populations may provide insight on how to target prevention efforts and reduce skin cancer-related morbidity and mortality in these groups.

## 2. Methods

This analysis was conducted on data from a national survey that explored correlates of sun protection among adults.

## 3. Sample

A sample of 1742 individuals was recruited through probability-based panels by survey research firm GfK (<http://www.gfk.com/>). These panels are representative of the adult population by using address-based sampling methodology. Stratified sampling was used to recruit participants from southern (Arizona, New Mexico, Louisiana, Alabama, Mississippi, Texas, California, Nevada, Florida, and Hawaii) and northern regions (all other states). Respondents were eligible to participate in the survey if they were: (1) 18–65 years old; (2) resided in the United States; and (3) were able to complete the survey in English. Participants provided informed consent prior to survey completion and received points in a GfK panel members rewards program. Respondents completed the survey online between November 13 and December 3, 2015. Participants were excluded from the analysis if they did not have race/ethnicity data available or did not identify as White, Black, Hispanic or Asian. A total of 115 participants were excluded for not meeting age criteria and 73 participants were excluded based on race/ethnicity data. The final analytic sample included 1554 participants. The Institutional Review Board at the University of Pennsylvania approved this study.

## 4. Survey instrument

The survey collected information on demographics and skin cancer risk, health behaviors, beliefs about tanning outdoors and body image, and behavioral attitudes toward sunscreen use, wearing a sleeved shirt, and seeking shade that were based on the Integrative Model of Behavioral Prediction and Change (Fishbein and Ajzen, 2010). Survey items were based on a belief elicitation study performed prior to survey development and review of existing literature examining epidemiologically established skin cancer risk factors, behavioral risk factors, and attitudes (Coups et al., 2008; Bränström et al., 2010).

### 4.1.1. Demographics and skin cancer risk

We assessed several characteristics: age, gender, education, household income and region of residence at time of survey (northern/southern). An adapted version of the brief skin cancer risk assessment tool (BRAT) developed by Glanz et al. (2003) was used to measure skin cancer risk (Glanz et al., 2003). The indicators assessed include personal and family history of skin cancer, mole count, sunburn history,

and sun sensitivity (skin color, hair color, ability to tan, ease of burning). BRAT scoring (range 0–108) is weighted based on the relative risk of melanoma associated with each factor. Participants with a score of 20 or less were categorized as “low risk” and those with a score of 21 or more were considered “moderate/high risk.” Glanz et al. (2003) confirmed validity of scoring in a subset of their sample.

### 4.1.2. Lifestyle characteristics

We asked participants to report the average number of days they exercise in a normal week, smoking status, and if they had a doctor's visit within the past year. Physical activity information was ascertained by asking respondents the following: “In an average week, on how many days do you engage in moderate or strenuous physical activity for at least 30 minutes without stopping?” The responses include 0–5 or more.

### 4.1.3. Tanning beliefs

Respondents were asked to indicate their level of agreement or disagreement for five items, which were combined to measure tanning beliefs: “Having a tan makes me look more attractive;” “Having a tan makes me look healthier;” “A tan is a sign of damaged skin” (reversed), “Tanning helps me to relax;” and, “Tanning in the sun helps to improve my mood.” Responses for each item were coded so a score of five represented the most positive tanning beliefs. (Scale 1–5; Alpha = 0.83; see Appendix A) (Zumbo et al., 2007).

### 4.1.4. Body image beliefs

We asked respondents to indicate their level of agreement or disagreement with each of the following statements: “I like my looks just the way they are;” “Most people would consider me good looking;” and, “I am physically unattractive” (reversed). Responses were coded so that the highest score represented the most positive body image beliefs, which were combined into a body image beliefs scale (Scale 1–5; Alpha = 0.72; see Appendix A) (Zumbo et al., 2007).

### 4.1.5. Attitudes toward sun protection

Participants were asked about their attitudes toward using sunscreen, wearing a sleeved shirt, and seeking shade using semantic differential scales. They were asked: “Using sunscreen/wearing a shirt/seeking shade the next time I am outdoors on a sunny day for more than an hour would be... bad/good, foolish/wise, unpleasant/pleasant, and harmful/beneficial” (Fishbein and Ajzen, 2010). These measures were combined into overall attitude scales for each behavior (Scale 1–7; Sunscreen: Alpha = 0.86; Sleeved shirt: Alpha = 0.89; Shade-seeking: Alpha = 0.91; see Appendix A) (Zumbo et al., 2007).

## 4.2. Outcome

### 4.2.1. Sun protection behaviors

Participants were asked on a 5-point Likert scale ranging from never to always: “Think about what you do when you are outside during the summer on a warm sunny day for more than an hour. How often do you... wear sunscreen, wear a shirt with sleeves that cover your shoulders, stay in the shade or under an umbrella?” These ordinal measures were included in the analyses as three separate primary outcomes of interest (Glanz et al., 2008).

## 4.3. Statistical analysis

We stratified the sample by racial/ethnic group (White, Black, Hispanic and Asian) and performed chi-square tests and analysis of variance (ANOVA) to test differences between participants in each group across demographic, lifestyle, and psychosocial factors. ANOVA was used to test differences across racial/ethnic groups in the performance of each behavior. Ordered logistic regression models were fitted for each primary outcome of interest for the total sample and each

**Table 1**  
Participant characteristics, lifestyle factors, and skin cancer risk from a racially and ethnically diverse sample of adults, 2015.

	Total sample (n = 1554; 100%)	White (n = 1078; 69%)	Black (n = 155; 10%)	Hispanic (n = 259; 17%)	Asian (n = 62; 4%)	Test of differences (ANOVA, chi-square, Fisher's Exact)
<b>Participant demographics, n (%)</b>						
<b>Age (years)</b>						p < 0.05 <sup>a</sup>
18–30	796 (51.2)	509 (47.2)	81 (52.3)	166 (64.1)	40 (64.5)	
31–65	758 (48.8)	569 (52.8)	74 (47.7)	93 (35.9)	22 (35.5)	
<b>Gender – Female</b>	793 (51.0)	531 (49.3)	92 (59.4)	137 (52.9)	33 (53.2)	p = 0.42 <sup>a</sup>
<b>Educational level</b>						
Less than high school or high school	500 (32.2)	311 (28.9)	53 (34.2)	120 (46.3)	16 (25.8)	p < 0.001 <sup>a</sup>
Some college	527 (33.9)	367 (34.0)	59 (38.1)	86 (33.2)	15 (24.2)	
Bachelor's degree or higher	527 (33.9)	400 (37.1)	43 (27.7)	53 (20.5)	31 (50.0)	
<b>Region – Northern</b>	694 (50.5)	552 (58.7)	71 (53.0)	47 (19.8)	24 (38.7)	p < 0.001 <sup>a</sup>
<b>Income</b>						
\$29,999 or less	366 (23.6)	193 (17.9)	72 (46.5)	88 (34.0)	13 (21.0)	p < 0.001 <sup>a</sup>
\$30,000–\$59,999	379 (24.4)	252 (23.4)	37 (24.9)	74 (28.6)	16 (25.8)	
\$60,000–\$99,999	373 (24.0)	280 (26.0)	27 (17.4)	57 (22.0)	9 (14.5)	
\$100,000 or more	436 (28.1)	353 (32.8)	19 (12.3)	40 (15.4)	24 (38.7)	
<b>Participant lifestyle factors, mean (SD) or n (%)</b>						
<b>Days of exercise in average week (range 0–5+)<sup>c</sup></b>	3.26 (1.7)	3.28 (1.7)	2.95 (1.6)	3.33 (1.7)	3.34 (1.5)	p = 0.06 <sup>b</sup>
<b>Smoking status</b>						
Never smoker	1072 (69.4)	725 (67.7)	113 (73.4)	183 (70.9)	51 (82.3)	p = 0.20 <sup>a</sup>
Current or former smoker	473 (30.6)	346 (32.3)	41 (26.6)	75 (29.1)	11 (17.7)	
<b>Most recent doctor's visit</b>						
At least 1 year ago	455 (29.5)	298 (27.8)	44 (28.6)	88 (34.1)	25 (40.3)	p = 0.22 <sup>a</sup>
Within the past year	1090 (70.6)	773 (72.2)	110 (71.4)	170 (65.9)	37 (59.7)	
<b>Skin Cancer Risk Score, range 0–66, n (%)</b>						
<b>Categorized risk score</b>						
Low risk (0–20)	418 (31.0)	168 (18.1)	116 (89.2)	100 (42.9)	34 (55.7)	p < 0.001 <sup>a</sup>
Moderate/high risk (21–66)	932 (69.0)	758 (81.9)	14 (10.8)	133 (57.1)	27 (44.3)	
<b>Psychosocial factors, mean (SD)</b>						
<b>Tanning beliefs scale (1–5)</b>	2.8 (0.9)	2.9 (0.8) <sup>†,‡</sup>	2.1 (0.8) <sup>§</sup>	2.6 (0.8) <sup>§,†,‡</sup>	2.6 (0.8) <sup>§,†</sup>	p < 0.001 <sup>b</sup>
<b>Body image (1–5)</b>	3.5 (0.8)	3.5 (0.7) <sup>†</sup>	3.9 (0.8) <sup>§,†,‡</sup>	3.5 (0.8) <sup>†</sup>	3.4 (0.7) <sup>†</sup>	p < 0.001 <sup>b</sup>
<b>Sunscreen attitudes (1–7)</b>	5.5 (1.2)	5.6 (1.2) <sup>†</sup>	5.0 (1.5) <sup>§,‡</sup>	5.5 (1.2) <sup>†</sup>	5.1 (1.3) <sup>§</sup>	p < 0.001 <sup>b</sup>
<b>Sleeved shirt attitudes (1–7)</b>	5.6 (1.3)	5.7 (1.3)	5.5 (1.4)	5.4 (1.4)	5.3 (1.3)	p < 0.05 <sup>b</sup>
<b>Shade-seeking attitudes (1–7)</b>	5.8 (1.3)	5.8 (1.3) <sup>†</sup>	5.8 (1.5) <sup>¶</sup>	5.7 (1.4) <sup>†</sup>	4.9 (1.4) <sup>§,†,‡</sup>	p < 0.05 <sup>b</sup>
<b>Sun protection behavior, mean (SD)</b>						
<b>Sunscreen (1–5)</b>	2.9 (1.2)	3.1 (1.2) <sup>†,‡</sup>	2.1 (1.2) <sup>§,†,‡</sup>	2.7 (1.2) <sup>§,†</sup>	2.8 (1.1) <sup>†</sup>	p < 0.001 <sup>b</sup>
<b>Sleeved shirt (1–5)</b>	3.5 (1.2)	3.6 (1.2)	3.3 (1.3)	3.4 (1.2)	3.5 (1.2)	p < 0.05 <sup>b</sup>
<b>Seek shade (1–5)</b>	3.0 (1.1)	3.0 (1.0)	2.9 (1.3)	3.0 (1.1)	3.2 (0.9)	p = 0.21 <sup>b</sup>
<b>Sun protection behavior, n (%)</b>						
<b>Sunscreen</b>						
Never, rarely or sometimes	1031 (67.0)	665 (62.4)	133 (86.9)	189 (73.5)	44 (71.0)	p < 0.001
Often or always	507 (33.0)	401 (37.6)	20 (13.1)	68 (26.5)	18 (29.0)	
<b>Sleeved shirt</b>						
Never, rarely or sometimes	534 (40.0)	356 (37.7)	54 (41.9)	100 (45.7)	24 (41.4)	p = 0.16
Often or always	816 (60.4)	588 (62.3)	75 (58.1)	119 (54.3)	34 (58.6)	
<b>Seek shade</b>						
Never, rarely or sometimes	1058 (68.8)	749 (70.3)	98 (64.1)	169 (65.8)	42 (67.7)	p = 0.28
Often or always	480 (31.2)	317 (29.7)	55 (36.0)	88 (34.2)	20 (32.3)	

<sup>a</sup> Chi-square.

<sup>b</sup> ANOVA with Bonferroni adjustment for multiple comparisons.

<sup>c</sup> Mean and standard deviation are displayed in Table 1.

<sup>§</sup> Statistically significantly different from Whites (p < 0.05).

<sup>†</sup> Statistically significantly different from Blacks (p < 0.05).

<sup>‡</sup> Statistically significantly different from Hispanics (p < 0.05).

<sup>¶</sup> Statistically significantly different from Asians (p < 0.05).

racial/ethnic group. All demographic, lifestyle and psychosocial factors were included in the models as independent variables. In multivariate models, a cutoff of p < 0.05 was used to determine statistical significance. Proportional odds ratios were specified by exponentiating the ordered logit coefficients to facilitate interpretation of results. We tested differences in adjusted odds ratios for each predictor variable across the groups within the three models (sunscreen use, wearing a sleeved shirt and seeking shade) using Wald tests. A cutoff of p < 0.05 was used to determine statistical significance of differences in adjusted

odds ratios. Bonferroni adjustments were used to account for multiple comparisons in all appropriate analyses. All analyses were conducted in Stata 14.2 (College Station, TX).

## 5. Results

### 5.1. Descriptive statistics

Of the 1554 participants in the total analytic sample, 1078 (69%)

identified as White, 155 (10%) as Black, 259 (17%) as Hispanic, and 62 (4%) as Asian (Table 1). In the total sample, 51% of participants were 18–30 years of age, 51% were female, and 34% reported having at least a bachelor's degree. Across racial/ethnic groups, the Hispanic and Asian groups were younger than the White and Black groups ( $p < 0.05$ ). The Asian population had the highest proportion with at least a bachelor's degree, followed by Whites, Blacks, and finally Hispanics. Higher proportions of the White and Asian populations reported a household income of \$100,000 or more as compared to Blacks and Hispanics ( $p < 0.001$ ). Skin cancer risk scores were statistically significantly different across racial/ethnic groups, with approximately 82% of Whites having moderate/high risk, followed by 57% of Hispanics, 44% of Asians and 11% of Blacks. Whites had the highest score for positive beliefs about tanning and Black had the lowest, whereas blacks had the highest score for positive body image views and Asians had the lowest. Regardless of the sun protection behavior, behavioral attitudes towards each behavior were positive across racial/ethnic groups. In general, scores tended to be higher among Whites compared to the other groups. No statistically significant differences were evident across racial/ethnic groups for exercise, smoking or recent doctor visits.

### 5.2. Performance of sun protection behaviors

Among the full sample, the sun protection behavior performed most frequently was wearing a sleeved shirt (mean = 3.49; SD = 1.21), followed by seeking shade (mean = 2.97; SD = 1.06), and then sunscreen use (mean = 2.92; SD = 1.22). Sunscreen use among Whites was significantly higher than Blacks ( $p < 0.001$ ) and Hispanics ( $p < 0.001$ ), while use among Blacks was significantly lower than Hispanics ( $p < 0.001$ ) and Asians ( $p < 0.001$ ). Although the p-value was less than 0.05 for differences across groups for wearing a sleeved shirt, no pairwise comparisons were statistically significant. No statistically significant differences were detected across racial/ethnic groups for seeking shade ( $p = 0.21$ ) (Table 1).

### 5.3. Multivariate ordered logistic regression modeling: Sunscreen use

Being female, having a bachelor's degree or higher, having a household income of \$30,000 or more, having a moderate/high skin cancer risk score, frequently exercising, and having a doctor's visit within the past year were associated with higher odds of using sunscreen among all participants (Table 2). No statistically significant associations were detected between sunscreen use and age, region of residence, or smoking status in the full sample. The adjusted odds ratios for gender and sunscreen use were statistically significantly different between Whites and Asians (aOR = 1.96 vs. 0.54;  $p < 0.05$ ) and Blacks and Asians (aOR = 2.88 vs. 0.54;  $p < 0.05$ ), although the adjusted odds ratio did not reach statistical significance among Asians. Adjusted odds ratios for education were also statistically significantly different between Whites and Asians (Some college: aOR = 1.48 vs. 0.09;  $p < 0.001$ , bachelor's or higher: aOR = 2.19 vs. 0.41;  $p < 0.05$ ), Blacks and Asians (Some college: aOR = 1.52 vs. 0.09;  $p < 0.05$ , bachelor's or higher: aOR = 3.03 vs. 0.41;  $p < 0.05$ ), and Hispanics and Asians (Some college: aOR = 0.78 vs. 0.09;  $p < 0.05$ , bachelor's or higher: aOR = 1.41 vs. 0.41;  $p < 0.05$ ). The association between sunscreen use and behavioral attitudes was positive for all groups, although the estimate among Blacks failed to reach statistical significance. In pairwise comparisons, the odds ratio for Whites was statistically stronger than for Blacks (aOR = 1.84 vs. 1.22;  $p < 0.05$ ) (Table 2). Except for body image and sunscreen use among Whites, tanning and body image beliefs were not statistically significantly associated with sunscreen use across the other racial/ethnic groups.

### 5.4. Multivariate ordered logistic regression modeling: sleeved shirt

Having a moderate/high skin cancer risk score, a recent doctor's

visit, and positive attitudes towards wearing a sleeved shirt were associated with increased use of this behavior among all participants (Table 3). Being female as compared to male, being a current or former smoker as compared to never smoking, and having positive beliefs about tanning were associated with lower odds of wearing a sleeved shirt. Compared to males, females were significantly less likely to practice this behavior among Whites, Blacks, and Hispanics. Adjusted odds ratios for age were statistically significantly different between Whites and Blacks (aOR = 1.41 vs. 0.53;  $p < 0.05$ ) and Blacks and Hispanics (aOR = 0.53 vs. 1.62;  $p < 0.05$ ). Among Hispanics, household income of \$60,000 or more significantly increased the odds of wearing a sleeved shirt. Adjusted odds ratios for smoking status were statistically significantly different between Whites and Hispanics (aOR = 0.65 vs. 1.48;  $p < 0.05$ ). Having positive tanning beliefs was associated with lower odds of wearing a sleeved shirt among all groups, but only reached statistical significance among Whites. Body image beliefs were not associated with wearing a sleeved shirt across racial/ethnic groups. Having positive behavioral attitudes towards wearing a sleeved shirt was positively associated with the behavior across groups, especially among Whites, Hispanics and Asians.

### 5.5. Multivariate ordered logistic regression modeling: Seeking shade

Among all respondents, being female and having positive behavioral attitudes were associated with higher odds of seeking shade, whereas positive tanning beliefs were associated with lower odds of seeking shade (Table 4). A statistically significant inverse association between tanning beliefs and seeking shade was also observed among the Whites and Hispanics. Among Blacks and Asians, the adjusted odds ratios for gender and shade seeking were not statistically significant, but there were statistical differences between the aORs between Blacks and Asians (aOR = 0.44 vs. 10.76;  $p < 0.05$ ). Among Whites, older respondents were significantly more likely to report shade seeking and current or former smokers were less likely to seek shade. Estimates for shade seeking in relation to having a recent doctor's visit were statistically significantly different between Whites and Asians (aOR = 0.90 vs. 0.07;  $p < 0.05$ ), Blacks and Asians (aOR = 3.52 vs. 0.07;  $p < 0.001$ ), and Hispanics and Asians (aOR = 1.58 vs. 0.07;  $p < 0.05$ ). Further, tanning belief estimates were statistically significantly different between Blacks and Asians (aOR = 1.17 vs. 0.20;  $p < 0.05$ ).

## 6. Discussion

This study presents an investigation of sun protection behaviors and factors associated with these behaviors across racial/ethnic groups to guide skin cancer prevention efforts. Beyond demographics, this study investigates lifestyle and psychosocial correlates of sun protection behaviors that are not typically available in multiethnic samples. While existing literature on correlates of sun protection among non-Whites tends to focus on a single minority population, this study offers a comparison across multiple minority populations. In this study, prevalence of sun protection behaviors was consistent with previous findings (Pichon et al., 2005; Santmyre et al., 2001; Friedman et al., 1994; Pichon et al., 2010). Overall, we found that wearing a sleeved shirt was the most prevalent behavior, followed by seeking shade and sunscreen use. A similar trend was detected across all racial/ethnic groups, which differs from prior studies in black and Hispanic populations that found shade seeking to be the most prevalent sun protection behavior (Coups et al., 2013; Andreeva et al., 2009; Santmyre et al., 2001). Our results indicate that differences across race/ethnicity were most apparent for sunscreen use and that Whites engage in this behavior significantly more often than Blacks and Hispanics. Whites, Hispanics and Asians were more likely to wear a sleeved shirt. However, people may be wearing sleeved shirts for reasons other than skin cancer prevention. Further, while some studies suggest that Blacks are more

**Table 2**  
Demographic, skin cancer risk, lifestyle and psychosocial factors associated with sunscreen use by racial/ethnic group.

Covariate <sup>a</sup>	Total	White	Black	Hispanic	Asian
Adjusted odds ratios (95% confidence interval)					
<b>Participant demographics &amp; skin cancer risk</b>					
Age (years)					
18–30	Ref	Ref	Ref	Ref	Ref
31–65	1.12 (0.91–1.39)	1.17 (0.90–1.51)	0.87 (0.39–1.94)	1.07 (0.62–1.86)	2.40 (0.63–9.11)
Gender					
Males	Ref	Ref	Ref	Ref	Ref
Females	1.77 (1.44–2.17)	1.96 (1.53–2.52) <sup>‡</sup>	2.88 (1.32–6.26) <sup>‡</sup>	1.81 (1.09–3.00)	0.54 (0.15–1.93) <sup>§,†</sup>
Education					
Less than high school or high school	Ref	Ref	Ref	Ref	Ref
Some college	1.20 (0.94–1.55)	1.48 (1.08–2.03) <sup>‡</sup>	1.52 (0.61–3.80) <sup>‡</sup>	0.78 (0.44–1.38) <sup>‡</sup>	0.09 (0.02–0.48) <sup>§,†,‡</sup>
Bachelor's or higher	1.85 (1.41–2.42)	2.19 (1.57–3.06) <sup>‡</sup>	3.03 (1.10–8.34) <sup>‡</sup>	1.41 (0.73–2.74)	0.41 (0.11–1.54) <sup>§,†</sup>
Region					
Northern	Ref	Ref	Ref	Ref	Ref
Southern	0.84 (0.68–1.02)	0.83 (0.64–1.06)	0.88 (0.43–1.82)	1.40 (0.75–2.62)	1.52 (0.48–4.84)
Income					
\$29,999 or less	Ref	Ref	Ref	Ref	Ref
\$30,000–\$59,999	1.43 (1.08–1.91)	1.29 (0.87–1.87)	0.96 (0.39–2.35)	1.24 (0.68–2.27)	1.22 (0.26–5.72)
\$60,000–\$99,999	1.77 (1.31–2.38)	1.29 (0.89–1.88)	2.29 (0.74–7.09)	2.33 (1.17–4.65)	0.37 (0.04–3.07)
\$100,000 or more	1.98 (1.47–2.67)	1.44 (0.99–2.09) <sup>*</sup>	2.11 (0.67–6.66)	3.37 (1.53–7.41) <sup>§</sup>	0.79 (0.34–1.71)
Skin cancer risk score					
Low	Ref	Ref	Ref	Ref	Ref
Moderate/High	1.79 (1.44–2.23) <sup>‡</sup>	1.08 (0.79–1.49)	0.63 (0.17–2.26)	1.55 (0.94–2.56)	0.78 (0.24–2.56)
<b>Participant lifestyle factors</b>					
Smoking status					
Never smoker	Ref	Ref	Ref	Ref	Ref
Current or former	0.81 (0.64–1.02)	0.71 (0.54–0.94)	0.61 (0.24–1.57)	1.13 (0.64–2.00)	0.32 (0.07–1.35)
Exercise	1.12 (1.06–1.19)	1.13 (1.05–1.22)	1.20 (0.95–1.51)	1.05 (0.91–1.22)	0.98 (0.68–1.43)
Recent doctor visit					
At least 1 year ago	Ref	Ref	Ref	Ref	Ref
Within past year	1.41 (1.14–1.75)	1.34 (1.03–1.75)	1.84 (0.83–4.07)	1.86 (1.11–3.10)	4.79 (1.26–18.30)
<b>Participant psychosocial factors</b>					
Tanning beliefs	1.10 (0.98–1.24)	0.96 (0.83–1.11)	1.52 (0.94–2.46)	1.01 (0.76–1.35)	0.76 (0.34–1.71)
Body image	1.08 (0.95–1.23)	1.18 (1.01–1.38)	1.13 (0.72–1.76)	1.09 (0.81–1.48)	1.08 (0.44–2.68)
Behavioral attitudes	1.70 (1.55–1.86)	1.84 (1.64–2.06) <sup>†</sup>	1.22 (0.92–1.61) <sup>§</sup>	1.52 (1.22–1.88)	2.07 (1.32–3.23)

<sup>a</sup> All covariates included in the table were included in each model.

<sup>‡</sup> Adjusted odds ratio statistically significantly different from Whites ( $p < 0.05$ ).

<sup>†</sup> Adjusted odds ratio statistically significantly different from Blacks ( $p < 0.05$ ).

<sup>\*</sup> Adjusted odds ratio statistically significantly different from Hispanics ( $p < 0.05$ ).

<sup>§</sup> Adjusted odds ratio statistically significantly different from Asians ( $p < 0.05$ ).

likely to seek shade than Whites, this study found that this behavior did not vary by group (Santmyre et al., 2001).

Differences in sun protection behavior across race/ethnicity were largely demographic in nature. Other studies have described several demographic factors associated with sun protection among minority groups (Buller et al., 2011; Coups et al., 2008; Coups et al., 2012; Coups et al., 2013; Andreeva et al., 2009; Ma et al., 2007; Pichon et al., 2005; Santmyre et al., 2001; Friedman et al., 1994; Pichon et al., 2010; Hall and Rogers, 1999). In prior work, gender, education and income have been associated with sunscreen use, but we did not find these associations across all groups (Coups et al., 2012; Coups et al., 2013; Andreeva et al., 2009; Pichon et al., 2005; Santmyre et al., 2001; Pichon et al., 2010). Females were more likely to use sunscreen across all groups except Asians and higher educational levels predicted use in Whites and Blacks only. We detected a trend of increasing sunscreen use with increasing income among Whites, Blacks and Hispanics, but higher income yielded a much greater increase in the odds of using sunscreen among Hispanics as compared to the other groups. Others have found income to be an important predictor of sunscreen use among Blacks (Pichon et al., 2010; Summers et al., 2011). An inverse trend between income and sunscreen use was observed among Asians, and to our knowledge, there are no other studies that have detected any association between income and sunscreen use in this racial group. In our study, gender was an important predictor of wearing a sleeved shirt for all groups except Asians. Similar to findings for sunscreen use, higher income was an important predictor of wearing a sleeved shirt among

Hispanics only. There were not many differences in the importance of demographic predictors of shade seeking detected between racial/ethnic groups. While lifestyle factors appear to have some effect on sun protection, engaging in risky health behaviors appear to be correlated with infrequent sun protection behavior regardless of racial/ethnic group.

Minimal variation was observed across racial/ethnic groups in the association between psychosocial correlates and sun protection behavior. Our findings suggest that positive tanning beliefs are not associated with sunscreen use, but were associated with a lower likelihood of wearing a sleeved shirt and seeking shade. Of note, there were a few instances in which there appeared to be a counter-intuitive positive association between positive tanning beliefs and higher odds of sun protection, but none of these estimates were statistically significant and are likely due to small sample size. This inverse relationship was similar across all racial/ethnic groups, suggesting that people who are more likely to desire a suntan regardless of race/ethnicity are more likely to engage in behaviors that enhance their potential to receive a suntan. Body image beliefs did not have a clear association with any sun protection behavior for any racial/ethnic group. We found positive behavioral attitudes to be associated with higher odds of sun protection, and while the importance of this predictor varied slightly across racial/ethnic groups, this relationship was consistent across all groups. In this study, inclusion of behavioral attitudes sheds some light onto how individuals' perceptions of sun protection contributes to performance of these behaviors, but further exploration of other psychosocial factors is

**Table 3**  
Predictors of sleeved shirt use by racial/ethnic group, ordered logistic regression.

Covariate <sup>a</sup>	Total	White	Black	Hispanic	Asian
Adjusted odds ratios (95% confidence interval)					
<b>Participant demographics &amp; skin cancer risk</b>					
Age (years)					
18–30	Ref	Ref	Ref	Ref	Ref
31–65	1.23 (0.99–1.51)	1.41 (1.09–1.81) <sup>†</sup>	0.53 (0.24–1.17) <sup>§,*</sup>	1.62 (0.95–2.78) <sup>†</sup>	0.42 (0.12–1.46)
Gender					
Males	Ref	Ref	Ref	Ref	Ref
Females	0.45 (0.37–0.55)	0.43 (0.34–0.55)	0.44 (0.21–0.92)	0.46 (0.28–0.75)	1.65 (0.48–5.69)
Education					
Less than high school or high school	Ref	Ref	Ref	Ref	Ref
Some college	0.86 (0.67–1.10)	0.78 (0.57–1.07)	1.33 (0.58–3.06)	1.09 (0.63–1.87)	0.56 (0.11–2.78)
Bachelor's or higher	1.04 (0.80–1.35)	0.95 (0.69–1.32)	2.02 (0.73–5.60)	1.29 (0.68–2.47)	0.88 (0.21–3.66)
Region					
Northern	Ref	Ref	Ref	Ref	Ref
Southern	1.06 (0.87–1.29)	1.10 (0.85–1.41)	0.70 (0.35–1.40)	1.33 (0.71–2.50)	0.72 (0.23–2.25)
Income					
\$29,999 or less	Ref	Ref	Ref	Ref	Ref
\$30,000–\$59,999	1.34 (1.01–1.78)	1.31 (0.90–1.91)	0.70 (0.29–1.66)	1.24 (0.68–2.27)	1.22 (0.26–5.72)
\$60,000–\$99,999	1.09 (0.81–1.47)	0.98 (0.67–1.43)	0.43 (0.14–1.34)	2.33 (1.17–4.65) <sup>†</sup>	0.37 (0.04–3.07)
\$100,000 or more	1.13 (0.84–1.52)	1.12 (0.77–1.62)	0.77 (0.26–2.32)	3.37 (1.53–7.41)	0.79 (0.34–1.71)
Skin cancer risk score					
Low	Ref	Ref	Ref	Ref	Ref
Moderate/High	1.31 (1.06–1.62)	1.30 (0.95–1.77)	1.10 (0.34–3.56)	1.14 (0.69–1.87)	0.88 (0.29–2.68)
<b>Participant lifestyle factors</b>					
Smoking status					
Never smoker	Ref	Ref	Ref	Ref	Ref
Current or former	0.76 (0.61–0.96)	0.65 (0.50–0.85) <sup>†</sup>	0.49 (0.19–1.22)	1.48 (0.83–2.62) <sup>§</sup>	0.90 (0.24–3.46)
Exercise	0.97 (0.92–1.03)	0.97 (0.90–1.04)	0.99 (0.80–1.23)	1.00 (0.87–1.15)	1.40 (0.98–2.01)
Recent doctor visit					
At least 1 year ago	Ref	Ref	Ref	Ref	Ref
Within past year	1.32 (1.06–1.63)	1.21 (0.93–1.58)	1.53 (0.75–3.12)	1.83 (1.11–3.02)	0.84 (0.23–3.12)
<b>Participant psychosocial factors</b>					
Tanning beliefs	0.70 (0.62–0.79)	0.63 (0.54–0.73)	0.86 (0.55–1.37)	0.75 (0.57–1.01)	0.73 (0.34–1.57)
Body image	0.92 (0.80–1.04)	0.96 (0.82–1.13)	1.42 (0.94–2.16)	0.89 (0.66–1.22)	0.47 (0.19–1.21)
Behavioral attitudes	1.50 (1.39–1.63)	1.55 (1.40–1.71)	1.28 (0.99–1.66)	1.45 (1.21–1.73)	1.70 (1.10–2.64)

<sup>a</sup> All covariates included in the table were included in each model.

<sup>§</sup> Adjusted odds ratio statistically significantly different from Whites ( $p < 0.05$ ).

<sup>†</sup> Adjusted odds ratio statistically significantly different from Blacks ( $p < 0.05$ ).

<sup>\*</sup> Adjusted odds ratio statistically significantly different from Hispanics ( $p < 0.05$ ).

warranted. Perceived skin cancer risk, perceived benefits of and barriers to sun protection, and skin cancer knowledge and sun protection may influence attitudes towards sun protection behaviors and may differ by racial/ethnic group. It may also be useful to consider how differences in skin color, skin color preference, and other sociocultural factors motivate attitudes towards sun protection behavior.

### 6.1. Strengths and limitations

The strengths of the current study are its multiethnic, probability based sample and the examination of tanning and body image beliefs and attitudes toward each behavior. However, limitations are important to note. First, despite probability-based sampling, participants may not be representative of the general population in that they were recruited from consumer panels for incentives. Also, the data reflect self-reported practice of sun protection behaviors. Second, we did not collect information on wearing hats, avoidance of peak sun exposure hours, or re-application of sunscreen and did not analyze data on wearing long pants or intentional tanning. These outcomes were minimally reported and there was very little variability across groups. These may be important outcomes to consider in future studies. Third, although we collected detailed race/ethnicity information, we were unable to include individuals from all reported races/ethnicities due to small sample sizes. For the groups that were included, we were still limited by small sample sizes, especially among Asians. This may have resulted in low power to find statistically significant associations between correlates and sun protection behaviors and also yielded very

wide confidence intervals. Lack of statistically significant findings also contributed to uncertain interpretations of pairwise comparisons across racial/ethnic groups. Fourth, the survey was conducted in the fall and this could affect responses regarding sun protection behavior. Additionally, region of residence was used to derive a stratified sample and some states span northern and southern regions. Therefore, it may have been ideal to use participant residential address to reduce potential for misclassification, but this was not a viable option in the current study. Further, this study was unable to examine heterogeneity in Hispanic population. This may be important for future work, as some studies have found varied engagement in these behaviors based on country of origin and acculturation among Hispanics (Coups et al., 2012; Coups et al., 2013; Weiss et al., 2012; Andreeva et al., 2009).

## 7. Conclusions

Trends in skin cancer diagnosis and survival among minority populations, coupled with low prevalence of engagement in sun protection behaviors, underscore the importance of efforts to promote primary prevention of skin cancer among people of color (Holman et al., 2018; Agbai et al., 2014; Vital Signs: Melanoma Incidence and Mortality Trends and Projections — United States, 1982–2030 [Internet]; Cockburn et al., 2006; Bellows et al., 2001; Byrd et al., 2004; Hu et al., 2009; Wu et al., 2011; Dawes et al., 2016; Cormier et al., 2006; Coups et al., 2008; Coups et al., 2012; Coups et al., 2013; Weiss et al., 2012). Public health education efforts on skin cancer and interventions to promote skin cancer prevention primarily target non-

**Table 4**  
Predictors of shade seeking use by racial/ethnic group, ordered logistic regression.

Covariate <sup>a</sup>	Total	White	Black	Hispanic	Asian
Adjusted odds ratios (95% confidence interval)					
<b>Participant demographics &amp; skin cancer risk</b>					
Age (years)					
18–30	Ref	Ref	Ref	Ref	Ref
31–65	1.24 (0.92–1.67)	1.44 (1.00–2.06)	0.87 (0.22–3.53)	1.02 (0.46–2.23)	5.75 (0.33–100.99)
Gender					
Males	Ref	Ref	Ref	Ref	Ref
Females	1.34 (1.00–1.78)	1.45 (1.02–2.05)	0.44 (0.10–1.85) <sup>§</sup>	1.33 (0.66–2.69)	10.76 (0.85–136.56) <sup>†</sup>
Education					
Less than high school or high school	Ref	Ref	Ref	Ref	Ref
Some college	0.92 (0.65–1.31)	1.18 (0.76–1.83)	0.33 (0.07–1.52)	0.79 (0.36–1.75)	0.27 (0.01–6.38)
Bachelor's or higher	1.27 (0.87–1.86)	1.41 (0.89–2.24)	5.40 (0.94–31.07)	1.16 (0.43–2.70)	0.05 (0.00–2.39)
Region					
Northern	Ref	Ref	Ref	Ref	Ref
Southern	1.23 (0.92–1.63)	1.24 (0.86–1.78)	0.61 (0.20–1.86)	2.15 (0.78–5.96)	0.08 (0.01–1.13)
Income					
\$29,999 or less	Ref	Ref	Ref	Ref	Ref
\$30,000–\$59,999	0.86 (0.57–1.29)	0.82 (0.49–1.40)	0.24 (0.05–1.18)	1.06 (0.45–2.49)	1.86 (0.12–29.36)
\$60,000–\$99,999	1.07 (0.70–1.63)	0.98 (0.58–1.65)	0.93 (0.15–5.73)	1.17 (0.42–3.26)	0.51 (0.01–24.28)
\$100,000 or more	1.20 (0.78–1.85)	1.05 (0.61–1.80)	1.60 (0.28–9.21)	0.95 (0.31–2.91)	0.21 (0.00–9.61)
Skin cancer risk score					
Low	Ref	Ref	Ref	Ref	Ref
Moderate/High	1.27 (0.92–1.75)	1.20 (0.75–1.91)	3.19 (0.30–34.25)	0.82 (0.39–1.74)	0.50 (0.02–11.91)
<b>Participant lifestyle factors</b>					
Smoking status					
Never smoker	Ref	Ref	Ref	Ref	Ref
Current or former	0.83 (0.60–1.15)	0.67 (0.46–0.98)	5.05 (0.76–33.42)	1.14 (0.52–2.52)	0.65 (0.03–14.99)
Exercise	1.00 (0.92–1.09)	0.99 (0.89–1.10)	1.02 (0.73–1.44)	1.00 (0.80–1.24)	0.66 (0.26–1.72)
Recent doctor visit					
At least 1 year ago	Ref	Ref	Ref	Ref	Ref
Within past year	1.08 (0.80–1.46)	0.90 (0.63–1.31) <sup>§</sup>	3.52 (0.91–13.58) <sup>§</sup>	1.58 (0.75–3.33) <sup>§</sup>	0.07 (0.01–0.69) <sup>§,†,*</sup>
<b>Participant psychosocial factors</b>					
Tanning beliefs	0.63 (0.53–0.74)	0.59 (0.48–0.74)	1.17 (0.55–2.50) <sup>†</sup>	0.64 (0.41–0.99)	0.20 (0.03–1.28) <sup>†</sup>
Body image	1.01 (0.85–1.21)	1.02 (0.82–1.27)	0.95 (0.48–1.89)	1.02 (0.65–1.60)	1.93 (0.44–8.47)
Behavioral attitudes	1.41 (1.25–1.58)	1.52 (1.31–1.76)	1.16 (0.74–1.81)	1.33 (0.99–1.80)	0.77 (0.32–1.82)

<sup>a</sup> All of the covariates included in the table were included in each model.  
<sup>§</sup> Adjusted odds ratio statistically significantly different from Whites (p < 0.05).  
<sup>†</sup> Adjusted odds ratio statistically significantly different from Blacks (p < 0.05).  
<sup>\*</sup> Adjusted odds ratio statistically significantly different from Hispanics (p < 0.05).  
<sup>‡</sup> Adjusted odds ratio statistically significantly different from Asians (p < 0.05).

Hispanic White populations. Limited public health education and interventions on skin cancer prevention targeted at minority populations may play a role in perpetuating discouraging trends in skin cancer diagnoses and prognoses among people of color. As skin cancer incidence is on the rise, we have an important opportunity to advance skin cancer prevention efforts in a highly diverse population. This study provides important insight into the practice and predictors of skin cancer prevention among minority populations and suggests that targeting skin cancer prevention efforts, such as targeting sunscreen use messaging to groups which were less likely to use sunscreen, including Blacks with less education, Hispanics with lower income, and Asian men. Further investigation of the correlates of sun protection among minority populations may be needed to guide targeted public health interventions.

**Appendix A. Composite measures**

	Individual item(s)	Response scale	Alpha <sup>a</sup>	Mean	SD
Tanning beliefs	1. Having a tan makes me look more attractive 2. Having a tan makes me look healthier 3. A tan is a sign of damaged skin (reverse coded) 4. Tanning helps me to relax 5. Tanning in the sun helps to improve my mood	1: Definitely disagree 2: Mostly disagree 3: Neither agree nor disagree 4: Mostly agree 5: Definitely agree	0.83	2.76	0.88
Body image	1. I like my looks just the way they are 2. Most people would consider me good looking 3. I am physically unattractive (reverse coded)	1: Definitely disagree 2: Mostly disagree	0.72	3.52	0.77

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**Conflict of interest**

The authors declare there is no conflict of interest.

Behavioral attitudes: sunscreener	Wearing sunscreen the next time I am outdoors on a sunny day for more than an hour would be... bad/good, foolish/wise, unpleasant/pleasant, and harmful/beneficial.	1 (Bad)–7 (Good) 1 (Foolish)–7 (Wise) 1 (Unpleasant)–7 (Pleasant) 1 (Harmful)–7 (Beneficial)	0.86	5.51	1.24
Behavioral attitudes: wearing sleeve shirt	Wearing a sleeved shirt the next time I am outdoors on a sunny day for more than an hour would be... bad/good, foolish/wise, unpleasant/pleasant, and harmful/beneficial.	1 (Bad)–7 (Good) 1 (Foolish)–7 (Wise) 1 (Unpleasant)–7 (Pleasant) 1 (Harmful)–7 (Beneficial)	0.89	5.58	1.31
Behavioral attitudes: seeking shade	Seeking shade the next time I am outdoors on a sunny day for more than an hour would be... bad/good, foolish/wise, unpleasant/pleasant, and harmful/beneficial.	1 (Bad)–7 (Good) 1 (Foolish)–7 (Wise) 1 (Unpleasant)–7 (Pleasant) 1 (Harmful)–7 (Beneficial)	0.91	5.75	1.32

<sup>a</sup> Polychoric alpha.

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