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Summer Sunburn and Sun Exposure Among US Youths Ages 11 to 18: National Prevalence and Associated Factors

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ABSTRACT. *Objective.* **Epidemiologic evidence suggests that ultraviolet radiation (UVR), from sun exposure and sunburns during early life, is associated with increased risk of melanoma and other skin cancers in adulthood. The objective of this study was to gather national, population-based data on sun exposure and protection behaviors among US youths ages 11 to 18 to quantify the magnitude and patterns of sun exposure and establish baselines for continued surveillance.**

Methods. **A nationwide survey based on random-digit dialing and stratified, 2-stage national probability sampling was conducted of households with telephones in the 48 contiguous states of the United States during July through October of 1998; a population-based sample of 1192 youth ages 11 to 18 was studied to measure weighted prevalence estimates of summer sunburn and sun exposure and adjusted prevalence odds ratios and 95% confidence intervals from logistic regression analyses of sunburn.**

Results. **Among youths ages 11 to 18, 72% reported having had at least 1 summer sunburn, 30% reported at least 3, and 12% reported at least 5 sunburns. Before receiving their most serious summer sunburn, 39% of youths reported having applied sunscreen. Factors associated with increased odds of sunburn included greater sun sensitivity, white race, age younger than 16 years, more hours spent outdoors, and high desirability of a tan.**

Conclusions. **Summer sunburn was the norm among US youths ages 11 to 18. The high frequency of sunscreen use during the sunburning episodes suggests the need to educate youth and parents better about proper use of these agents, as well as the importance of practicing other sun protection behaviors, such as wearing hats and protective clothing and avoiding the sun during peak exposure times. These data may serve as a baseline for tracking progress in skin cancer prevention efforts and will inform the crafting of future public health campaigns.** ***Pediatrics*** **2002;110:27–35;** ***youth, skin cancer prevention, sunburn, behaviors, prevalence, national survey.***

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ABBREVIATIONS. UVR, ultraviolet radiation; ACS, American Cancer Society; CI, confidence interval; aPOR, adjusted prevalence odds ratio.

Ultraviolet radiation (UVR) from sun exposure is the number 1 modifiable risk factor for skin cancer, including melanoma. The common nonmelanoma skin cancers are associated with exposure to UVR,[1,2] and a growing body of epidemiologic evidence suggests that UVR from sun exposure and sunburns during early life is associated with increased risk of melanoma in adulthood.[3–6] Melanoma incidence rates increased an average of 2.7% per year in the United States from 1992 through 1998.[7] Therefore, successful skin cancer prevention efforts must focus on keeping children and young adults from acquiring dangerous levels of sun exposure during this high-risk period of life.

In response to this public health problem and in accordance with a national effort to advance the science of skin cancer prevention programs, the American Cancer Society (ACS) has focused on sun protection as a national cancer control priority, specifically for youths ages 11 to 18. Historically, efforts in the United States have been aimed at parents and teachers of younger children.[8] Several recent studies among youths in Australia, New Zealand, and the United States suggest that as children become adolescents, their levels of sun exposure and number of sunburns increase while practices of sun protection behaviors decrease relative to younger children and adults.[9–14] Some data indicate that despite high levels of knowledge about the health effects of unprotected sun exposure, changes in attitudes and social norms during adolescence are associated with increased adoption of high-risk behaviors and present a unique challenge to health educators.[10,14–18] Overall, sun protection programs have reported more success in improving sun protection practices for infants (by parents) and among younger children but less success among adolescents.[19]

For designing and evaluating skin cancer prevention programs targeted to adolescent youth, surveillance data are needed to quantify the magnitude and patterns of sun exposure and to establish baseline data. Although a national study regarding behaviors of parents and about their children ages 11 and under was published recently,[13,14] no national, population-based data on sun exposure and protection behaviors among US youths ages 11 to 18 were avail-

able on which to set goals in 1998. A national survey for youths and their parents was designed to produce baseline sun exposure and sun protection data. The ACS plans to repeat the survey periodically using similar methods to evaluate educational campaigns and track progress. We present national data on the prevalence of and factors associated with sunburn and sun exposure behaviors from a population-based telephone survey of 1192 youths aged 11 to 18 in the continental United States during the summer of 1998.

METHODS

The ACS conducted a telephone-based, nationally representative survey of the noninstitutionalized civilian population of youths 11 to 18 years of age and living in households in 48 states (excluding Alaska and Hawaii) to provide estimates of sun exposure, sun protection behaviors, attitudes, and awareness of skin cancer and sun protection information. Data were collected from July through October 1998. The ACS Sun Survey consisted of a youth interview, requiring permission from a parent or caregiver, and an almost identical parent module asking questions about sun exposure and sun protection. The survey's overall response rate of 57.7% was defined as the percentage of the eligible population who completed 1 or both child/parent interviews and was calculated using standard response rate formulas. A detailed description of the ACS Sun Survey methods were published previously.[20] Given our study's aim, our analysis concentrates only on the youth data.

Definitions

Sunburn

Sunburn was defined as "any reddening of the skin that lasts at least 12 hours, received either from being out in the sun or from using a tanning bed or sunlamp." Respondents were asked the following questions: 1) "Did you get a sunburn during the past weekend? Was the sunburn painful?" 2) "Have you had a sunburn this summer? If yes, how many times were you sunburned during this summer? What were you doing when you received your most serious sunburn this summer?"

Sun Sensitivity Index

We used a modification of the sun sensitivity index, a validated measure suitable for epidemiologic research,[21] to categorize youths into high, medium, and low levels of phenotypic (physical) susceptibility to sun exposure. The phenotypic characteristics that we used were self-reports of skin type, susceptibility to sunburn and ability to tan, the natural color of the skin, and (undyed) hair color.

Sun Exposure

We estimated the total average hours per week spent outdoors during this summer by summing the responses to 2 questions: 1) "On average during this summer, about how many hours per week did you spend outdoors between 10 AM and 4 PM on weekdays only?" 2) "On average during this summer, about how many hours per week did you spend outdoors between 10 AM and 4 PM on weekends?" Separate questions were asked about activities performed outdoors during the weekdays and weekend, and up to 4 activities were coded for each respondent. The activities were coded into 5 groups: 1) participating in or watching outdoor recreational activities, 2) sunbathing, 3) working outside for pay, 4) water sports, and 5) socializing.

Sun Protection Behaviors

A general question about use of sunscreen lotion "when outside on a very sunny day during the summer for more than 1 hour" had a 5-point Likert scale response format ranging from never to always. Youths who reported having had at least 1 summer sunburn were asked additional questions: "Did you do anything to protect yourself from the sun before you received your most serious sunburn this summer?" and, "What did you do to protect yourself from the sun?" Up to 3 answers were coded per respondent in the following categories: 1) wore long-sleeve shirt and/or pants, 2) wore a baseball cap, 3) wore a hat with 2+ inch brim, 4) wore sunscreen with 15+ SPF, or 5) stayed in the shade.

Attitudinal Correlates Related to Sun Protection

Factor analysis of 6 attitude questions produced 2 independent attitudinal factor scales reflecting barriers to and benefits of sun protection.[20] The first factor, termed barrier to sun protection, represents youths' attitude toward desiring a tan and was measured from 2 items—1) "I feel healthy when I have a nice tan," and 2) "I look better when I have a tan"—that had a reliability coefficient Cronbach $\alpha = 0.69$. A youth who scored low on this barrier to sun protection factor would perceive a tan to be less desirable than would a youth with a high score. The second factor, benefits of sun protection, was measured from 4 items: 1) "protecting my skin from the sun is an easy way to stay healthy," 2) "using sunscreen lotion allows me to enjoy the outdoors with less worry," 3) "spending time in the sun without any protection can increase my chances of developing cancer," and 4) "my skin won't wrinkle as fast if I spend less time in the sun"; these 4 items had a Cronbach $\alpha = 0.58$. A youth who scored high on this item would perceive the benefits of sun protection to be more desirable than would a youth with a low score. Overall average scores assessing barriers and benefits of sun protection attitudes were derived for each factor separately by averaging the responses from the relevant items. Youths were categorized into high, medium-high, medium-low, or low groups according to the quartile distribution of each factor score.

Analysis

The analytic study sample consisted of 1192 youths aged 11 to 18. Weighted statistics were used to describe the study sample. Detailed documentation on the computation of sample weights has been published previously.[20] All statistical analyses, including logistic regression, were conducted using SUDAAN[22] to compute appropriately the standard errors of the prevalence estimates and 95% confidence intervals (CI) of the prevalence odds ratios. First, we generated weighted frequencies for phenotypic sensitivity, sun exposure, and sunburn behaviors for the total population. Next, self-reported phenotypic sensitivity to sun exposure characteristics were examined for differences by age, gender, and race categories using χ^2 tests with $\alpha = 0.01$. Finally, patterns of sun exposure behaviors and sunburn in youths were examined for differences by age, gender, and sun sensitivity index categories using χ^2 tests with $\alpha = 0.01$.

Univariate logistic regression analyses were used to examine the crude association between factors of interest and each outcome: 1 to 4 summer sunburns and 5 or more summer sunburns versus none and sunburn during the past weekend versus none. On the basis of the literature[10,14,15,21,23] age, gender, race, household sociodemographics, and sun sensitivity were assessed as potential confounders. Multivariate logistic regression analyses were conducted for each outcome to obtain adjusted prevalence odds ratios (aPOR) and 95% CI for the covariates. Final models were determined through a stepwise backward elimination process, and statistical significance was assessed by the Wald statistic. A potential confounder remained in the final model if its removal was associated with a >10% change in the β coefficient or if it was consistently reported in the literature.

RESULTS

Self-Reported Phenotypic Sensitivity to Sun Exposure

General descriptive characteristics of this sample of US youths and their parents have been published previously.[20] Overall, nearly a quarter of this youth sample exhibited high sun sensitivity in 1998: 63.3% characterized their complexions as very fair or fair, 23.7% had repeated sunburns when exposed to repeated summer sun, and 40.3% had severe sunburn with blisters or peeling after 1 hour of unprotected exposure to midday summer sun (Table 1). Sun sensitivity did not vary by gender but did vary by age

TABLE 1. Self-Reported Phenotypic Sensitivity to Sun Exposure Among US Youths by Age, Gender, and Race, 1998

	All (%; n = 1192)	Age (%)			Gender (%)		Race (%)				
		11–13 (n = 503)	14–16 (n = 289)	17–18 (n = 400)	Boys (n = 600)	Girls (n = 592)	Black (n = 58)	White (n = 1016)	Asian/Pacific Islander (n = 24)	Native American (n = 26)	Other (n = 68)
Skin reaction after 1 h of exposure to summer sun											
Severe sunburn with blisters	11.5	15.2	8.5	9.3	14.3	8.3	13.3	11.6	23.0	9.3	4.6
Severe sunburn with peeling	28.8	37.0	28.7	25.4	30.1	27.6	8.4	31.4	10.8	28.8	29.9
Mild sunburn, some tanning	31.0	27.8	36.	31.2	27.5	34.6	14.1	33.4	23.3	16.0	31.9
Turning darker, no sunburn	14.0	11.5	13.0	17.7	12.5	15.6	30.6	11.3	28.4	14.6	20.0
No sunburn or tanning	14.6	13.5	13.8	16.6	15.5	13.7	33.6	12.4	14.5	31.3	13.6
χ^2 test			P = .03		P = .02				NC		
Skin reaction after repeated exposure to summer sun											
Repeated sunburn	23.7	30.5	18.4	19.8	23.9	23.6	17.2	25.9	8.0	8.9	20.8
No tan; freckles	6.3	7.4	6.6	4.7	5.7	6.9	7.2	6.7	0	12.2	1.3
Mild tan	25.3	26.8	29.8	20.3	24.6	25.9	34.2	24.7	22.9	22.8	24.9
Moderate tan	27.9	18.2	23.3	35.2	29.3	26.5	18.5	27.8	39.4	28.9	32.3
Deep tan	16.9	17.2	11.9	20.0	16.6	17.1	23.0	15.0	29.7	27.2	20.7
χ^2 test			P < .00001		P = .86				NC		
Natural skin color											
Very fair	14.3	11.6	17.6	14.9	12.8	15.6	2.7	16.7	0	16.6	6.4
Fair	49.0	49.4	51.4	47.3	51.6	46.6	8.8	55.8	30.5	24.7	38.8
Olive	12.0	10.6	10.4	14.6	8.9	15.1	4.7	12.2	20.7	15.4	11.3
Light brown	21.5	24.6	18.5	20.2	23.0	20.1	52.1	14.5	18.9	43.3	42.0
Dark brown	3.2	3.9	2.1	3.0	3.7	2.6	31.7	0.9	0	0	1.5
χ^2 test			P = .001		P = .02				NC		
Natural hair color											
Black	8.7	8.6	7.9	9.5	11.4	6.0	42.0	3.2	44.7	10.8	16.8
Dark/medium brown	45.3	40.6	48.6	48.3	47.8	42.7	42.2	43.6	42.5	43.9	66.2
Light brown	19.9	22.1	17.1	19.4	18.8	21.0	7.6	22.3	4.4	18.5	14.5
Blonde	22.3	25.4	22.9	18.2	19.5	25.0	5.3	26.9	8.5	12.0	2.4
Red	3.9	3.4	3.6	4.6	2.5	5.3	3.0	4.1	0	14.8	0
χ^2 test			P = .22		P = .002				NC		
Skin sensitivity index*											
Low	29.8	25.8	25.9	37.2	29.1	30.6	76.1	20.9	71.1	35.4	55.0
Moderate	46.6	44.8	54.0	43.5	50.2	42.9	19.0	50.7	20.6	54.7	40.4
High	23.6	29.4	20.2	19.2	20.8	26.5	4.9	28.5	8.3	9.9	4.6
χ^2 test			P = .001		P = .048				NC		

NC indicates not calculated.

* Skin sensitivity index categorized youths into high, medium, and low levels of phenotypic (physical) susceptibility to sun exposure. The phenotypic characteristics included were self-reports of skin type, susceptibility to sunburn and ability to tan, the natural color of the skin, and the undyed hair color.

and race; 11- to 13-year-olds and whites were significantly more likely than older youths and other races, respectively, to report high sun sensitivity. Heterogeneity of sun sensitivity was present within race groups. Among black youths, 11.5% described their skin color as very fair or fair and 21.7% reported severe sunburn with blisters or peeling after 1 hour of exposure to summer sun. Among white youths, 72.5% described themselves as fair or very fair, and 43.0% reported severe sunburn with blisters of peeling after 1 hour of exposure to summer sun.

Sunburn and Sun Exposure Behaviors

The vast majority of youths (72.4%) had at least 1 summer sunburn; 11.9% reported having had 5 or more sunburns during the summer of 1998 (Table 2). The prevalence of sunburn "during the past weekend" was 9.1%, with nearly one third of those painful sunburns. Youths with high sun sensitivity were 3 times more likely to have had 5 or more sunburns compared with those with low sun sensitivity.

Among youths who experienced at least 1 summer sunburn, 39.2% reported having used a sunscreen lotion with SPF 15+ before receiving their most serious sunburn of the summer (Table 2). Youths ages 11 to 13, girls, and those with high sun sensitivity were most likely to report having used sunscreen lotion with SPF 15+ before receiving their most serious sunburn. Wearing protective clothing, wearing a wide-brim hat, or staying in the shade before receiving the most serious summer sunburn were infrequent behaviors (<5%). Among youths who experienced at least 1 sunburn, more than half (57.4%) were participating in water sports, including swimming, when they received their most serious sunburn; youths ages 11 to 13 were the most likely to be sunburned in the context of water sports (68.4%). Girls were more likely than boys to receive their most serious sunburn while sunbathing (22.3% vs 9.9%), whereas boys were more likely than girls to have been sunburned while working outside (10.2% vs 2.3%).

Nearly 1 in 5 youths spent on average >32 total hours outdoors between 10 AM and 4 PM over a typical summer week, or at least 4 hours of peak UV exposure per day (Table 3). Boys (23.4%) and youths aged 16 to 18 years (23.0%) were more likely to be in this high sun exposure group. The 2 most common outdoor activities participated in by youth, between 10 AM and 4 PM on weekends, were participating in or watching sports (62.4%) and swimming or water sports (45.1%). Sun exposure while working (for pay) outdoors on weekdays occurred nearly 4 times more often among youths aged 16 to 18 compared with those aged 11 to 13 (36.8% vs 9.8%).

Correlates of Sunburn

This study reports the analytic results for 3 outcomes: 1 to 4 total summer sunburns, 5 or more total summer sunburns, and sunburn the past weekend (Table 4). Compared with youths who reported having had no summer sunburn, youths ages 11 to 13 (aPOR: 1.9; 95% CI: 1.3–2.8) and ages 14 to 15 (aPOR: 1.9; CI: 1.2–3.0) were nearly 2 times as likely as youths ages 16 to 18 to report having experienced between 1 and 4 summer sunburns. White youths were 2.9 times (95% CI: 1.8–4.5) more likely to have experienced 1 to 4 summer sunburns than youths of other races. Youths of high and moderate sun sensitivities were 2.6 and 1.7 times more likely, respectively, to have experienced 1 to 4 summer sunburns compared with youths with low sun sensitivity. Youths with high appeal for a tan were twice as likely to have experienced 1 to 4 summer sunburns compared with youths with low appeal for a tan. Relative to youths with low perceived benefits from practicing sun protection, those with medium perceived benefits from sun protection were more likely to have experienced 1 to 4 summer sunburns compared with none.

Youths with moderate and high sun sensitivity were 7.6 and 31.7 times more likely, respectively, to have experienced 5 or more summer sunburns relative to youths with low sun sensitivity. Compared with youths who spent 8 or fewer hours per week outdoors between 10 AM and 4 PM on average, those with an average of 9 to 31 hours outdoors per week were 8.7 times (95% CI: 2.8–26.7) more likely to have experienced 5 or more summer sunburns. The odds ratio for the highest sun exposure group, 32 to 42 hours per week, was not statistically different from 1 (aPOR: 3.8; 95% CI: 0.9–16.8). The odds of experiencing 5 or more summer sunburns was 3.1 times higher (95% CI: 1.2–8.3) among youths who reported that they knew someone who had skin cancer compared with those who knew no one with skin cancer.

Sunburn during the past weekend was associated with 2 modifiable factors. Youths who reported having ever sunbathed during summer weekdays or weekends had twice the odds (aPOR: 2.0; 95% CI: 1.1–3.7) of a sunburn the past weekend than those who never sunbathed. Hearing information about sun protection from friends or family almost daily compared with never hearing such information was associated with a 2.8 times higher (95% CI: 1.4–5.7) odds of having a sunburn last weekend.

DISCUSSION

The ACS Sun Survey provides sunburn and sun exposure data from a population-based, national survey of youths ages 11 to 18 years in the United States. Surveillance of sunburn, as a marker of underprotected sun exposure among susceptible populations, is one way to track progress toward the goal of preventing future skin cancer occurrence. The proportion of youths who reported having had summer sunburns in 1998 was substantial, with 72.4% reporting at least 1, 29.5% reporting 3 or more, and 11.9% reporting 5 or more sunburns. Factors independently correlated with summer sunburn and not subject to modification included age younger than 16, white race, and moderate to high sun sensitivity. Four modifiable factors associated with increased odds of sunburn were also identified: higher desirability of a tan, lower perceived benefits of sun protection, deliberate sunbathing, and higher levels of summer sun exposure during the hours of 10 AM to 4 PM. Thirty-nine percent of youths reported having applied sun-

TABLE 2. Prevalence of Summer Sunburn* Behaviors Among US Youths by Age, Gender, Sun Sensitivity, and Race, 1998

	All (%)	Age (%)			Gender (%)		Sun Sensitivity Index (%)			Race (%)				
		11–13 (n = 503)	14–15 (n = 289)	16–18 (n = 400)	Boys (n = 600)	Girls (n = 592)	Low (n = 316)	Medium (n = 589)	High (n = 287)	Black (n = 58)	White (n = 1016)	Asian/ Pacific Islander (n = 24)	Native American (n = 26)	Other (n = 68)
Sunburn past weekend														
Yes, painful	2.8	3.0	1.2	3.5	2.8	2.7	2.8	2.7	0.8	2.9	5.0	0	2.4	3.1
Yes, not painful	6.3	5.3	9.4	5.3	6.8	6.8	6.8	6.8	5.9	6.9	5.7	3.6	14.9	7.6
None	90.9	91.7	89.3	91.1	90.4	90.4	90.4	90.4	93.3	90.2	89.3	96.4	82.7	89.3
χ^2 test			P = .19		P = .83			P = .83				NC		
Frequency of summer sunburns														
0	27.6	14.4	21.1	35.7	29.2	25.4	29.2	25.4	44.8	22.7	14.5	63.3	41.6	3
1–2	42.9	47.8	44.0	36.5	43.2	42.7	43.2	42.7	39.2	46.6	40.4	22.1	29.3	52.3
3–4	17.6	16.6	21.1	16.3	17.5	17.6	17.5	17.6	9.7	18.4	26.3	12.0	14.3	6.5
5–9	7.8	7.2	9.4	7.3	6.2	9.4	6.2	9.4	5.0	7.7	11.6	0	4.1	3.3
10+	4.1	4.0	4.4	4.1	3.9	4.4	3.9	4.4	1.3	4.5	7.2	2.6	10.7	2.0
χ^2 test			P = .032		P = .42			P = .03				NC		
Protection taken before occurrence of most serious summer sunburn														
Protective clothing	2.1	1.4	2.1	3.0	2.2	1.9	2.2	2.0	2.0	0	2.3	0	5.1	0
χ^2 test			P = .55		P = .78			P = .99				NC		
Wide-brim hat	1.2	0.1	0.3	3.5	1.7	0.8	1.3	1.3	1.0	0	1.3	0	6.1	0
χ^2 test			P = .04		P = .34			P = .91				NC		
Baseball hat	4.5	4.2	6.0	3.7	5.3	3.8	6.3	3.5	4.8	13.8	4.6	0	5.1	0
χ^2 test			P = .61		P = .28			P = .45				NC		
Sunglasses	1.4	1.9	0.7	1.2	1.2	1.6	2.9	0.9	1.0	4.0	1.3	0	5.1	0
χ^2 test			P = .48		P = .62			P = .33				NC		
Sunscreen with SPF 15+	39.2	47.4	36.5	30.4	30.0	48.4	28.8	40.5	45.9	49.8	40.2	13.4	41.6	0
χ^2 test			P = .0005		P < .00001			P = .005				NC		
Stayed in shade	2.1	1.3	4.3	1.2	1.6	2.5	5.6	0.7	1.5	16.1	1.8	0	0	0
χ^2 test			P = .37		P = .48			P = .08				NC		
Activity† performed during serious summer sunburn‡														
Non-water sports/recreation	21.1	20.0	19.2	24.2	22.2	20.0	25.4	19.9	19.4	46.0	20.1	34.0	23.4	16.8
χ^2 test			P = .43		P = .47			P = .39				NC		
Lying out or sitting in sun	16.1	14.0	17.3	17.9	9.9	22.3	13.9	19.4	12.0	13.9	16.0	7.0	12.1	21.6
χ^2 test			P = .44		P < .00001			P = .06				NC		
Working outside (paid)	6.2	2.5	6.1	11.4	10.2	2.3	6.3	5.7	7.0	0	6.0	0	8.1	3.0
χ^2 test			P = .002		P = .0001			P = .87				NC		
Swimming or water sports	57.3	68.4	58.8	41.0	59.5	55.2	51.3	58.8	59.7	46.5	58.3	35.6	54.7	56.4
χ^2 test			P < .00001		P = .27			P = .25				NC		
Gardening, home repair	4.0	2.4	3.1	6.8	4.8	3.1	3.2	4.0	4.5	0	4.1	23.4	0	0
			P = .13		P = .31			P = .86				NC		

NC indicates not calculated.
* Sunburn is defined as any reddening of the skin that lasts for at least 12 hours, received either from exposure to the sun or from a tanning booth or sunlamp.
† Respondents could report up to 3 activities; totals will not equal 100%.
‡ Question asked only of those participants who reported having "at least 1 sunburn this summer."

TABLE 3. Prevalence of Summer Sun Exposure Behaviors Among US Youths by Age, Gender, Sun Sensitivity, and Race, 1998

	All (%) (n = 1192)	Age (%)			Gender (%)		Sun Sensitivity Index (%)		
		11–13 (n = 503)	14–15 (n = 289)	16–18 (n = 400)	Boys (n = 600)	Girls (n = 592)	Low (n = 316)	Medium (n = 589)	High (n = 287)
Total no. hours spent outdoors per week (10 AM–4 PM)									
0–8	23.4	29.4	22.0	17.6	21.4	25.5	25.9	21.4	24.3
9–31	57.1	54.3	28.3	59.4	55.2	59.0	55.4	58.1	57.2
32–42	19.5	16.4	19.0	23.0	23.4	15.5	18.7	20.6	18.5
χ^2 test			P = .006		P = .009			P = .73	
Main activities outdoors on weekdays*									
Nonwater sports/recreation	66.2	70.4	68.7	59.5	69.6	62.7	69.6	68.4	57.5
χ^2 test			P = .008		P = .03			P = .01	
Sunbathing or sitting in the sun	7.9	6.2	8.0	9.6	4.4	11.4	6.5	8.4	8.5
χ^2 test			P = .29		P = .0001			P = .56	
Working outside (paid)	21.6	9.8	19.1	36.8	25.5	17.6	21.0	2.7	20.1
χ^2 test			P < .00001		P = .004			P = .73	
Swimming or water sports	41.9	41.4	42.1	39.3	36.0	48.1	37.6	43.9	43.6
χ^2 test			P = .44		P = .0002			P = .23	
Socializing	17.1	20.6	14.8	14.6	14.1	20.0	19.5	16.4	15.1
χ^2 test			P = .072		P = .02			P = .43	
Main activities outdoors on weekends*									
Nonwater sports/recreation	62.4	73.0	52.9	57.0	67.2	57.5	62.2	61.4	64.6
χ^2 test			P < .00001		P = .002			P = .73	
Sunbathing or sitting in the sun	8.2	5.7	7.8	11.4	5.3	11.2	7.6	8.5	8.4
χ^2 test			P = .033		P = .001			P = .90	
Work outside (paid)	16.5	8.9	16.1	25.5	19.1	13.9	14.7	16.1	19.4
χ^2 test			P < .00001		P = .03			P = .43	
Swimming or water sports	45.1	43.9	44.5	46.9	39.8	50.6	38.7	48.1	47.2
χ^2 test			P = .71		P = .0009			P = .04	
Socializing	19.9	18.5	23.7	18.9	17.6	22.3	22.6	20.7	14.9
χ^2 test			P = .30		P = .07			P = .05	

* Respondents could report up to 3 activities; totals will not equal 100%.

screen lotion with SPF 15+ before their most serious summer sunburn, demonstrating either an improper application of sunscreen or an overestimation of its protective ability among US youths ages 11 to 18. Most of the youths reported having engaged in water sports when they received their most serious sunburn of the summer.

The data from this telephone-based prevalence survey have several limitations. First, sun sensitivity, exposure, and protection behavior information were self-reported by youths. Although the questionnaire was pilot tested in youths ages 11 to 18 and language adjusted accordingly, younger children may not have had as many opportunities to judge adequately their sun sensitivities. The survey was conducted from July through October, and interviews completed later may have been subject to more recall bias about summer sunburn compared with those conducted earlier. In an effort to minimize recall bias, the survey sampling was organized by geographic/UV regions, began by dialing numbers in northern regions in July, and finished with the southern regions in September through October, in addition to limiting questions to experience during the past summer and the past weekend. Survey resource constraints and the application of random-digit dialing did not permit oversampling of youths from nonwhite races or extension of the sample to Hawaii and Alaska. Although we present data for all races and did not limit the sample to whites, these data may underrepresent lower socioeconomic status and minority households, who are less likely to have a telephone.[24]

This nationwide, population-based survey of US youths ages 11 to 18 and their parents is the largest sample of paired interviews in the published literature. The presentation of youth data for racial groups other than whites complements other studies in the literature to date. Substantial diversity was observed both between and, importantly, within racial groups with regard to sun sensitivity, sun exposure, and protection. This underscores the inadequacy of race as a surrogate for sun sensitivity when other information is potentially available, at least among US youths at the turn of the century. Another strength was the direct interviewing of boys and girls ages 11 to 18 about their summer sun exposure and protection behaviors. Self-reported behaviors by youths may be more likely than a parental report to be accurate, as parents are usually not directly observing a large proportion of their middle and high school–aged child's behavior outdoors during the summer. Furthermore, with respect to sun exposure and protection practices, youths may not necessarily be biased toward giving socially desirable responses.[25]

Although not directly comparable because of different geographical regions and age groups surveyed, our findings of high sunburn rates are generally consistent with those reported in the literature. Population-based data regarding prevalence of sun exposure behaviors and sunburn specifically among

TABLE 4. Correlates of Sunburn among US Youths Ages 11 to 18: Multiple Logistic Regression Analysis*

	1–4 Summer Sunburns Versus None (n = 950)		5+ Summer Sunburns Versus None (n = 300)		Sunburn Past Weekend Versus No Weekend Sunburn (n = 1192)	
	aPOR	95% CI	aPOR	95% CI	aPOR	95% CI
Age group (y)						
11–13	1.90	(1.28–2.81)	1.69	(0.62–4.62)	0.90	(0.51–1.57)
14–15	1.89	(1.19–2.98)	1.59	(0.55–4.60)	1.18	(0.64–2.20)
16–18	1.0	Referent	1.00	Referent	1.00	Referent
Gender						
Male	0.82	(0.58–1.16)	1.44	(0.60–3.44)	1.09	(0.67–1.77)
Female	1.00	Referent	1.00	Referent	1.00	Referent
Race						
White	2.88	(1.84–4.50)	···		0.75	(0.39–1.45)
Other	1.00	Referent	···		1.00	Referent
Sun sensitivity index						
Low	1.00	Referent	1.00	Referent	1.00	Referent
Moderate	1.67	(1.13–2.47)	7.60	(2.39–24.18)	1.61	(0.85–3.07)
High	2.62	(1.50–4.59)	31.70	(9.14–109.95)	1.75	(0.86–3.59)
Tan desirability score						
Low	1.00	Referent	···		···	
Medium-low	1.46	(0.88–2.40)	···		···	
Medium-high	1.43	(0.78–2.62)	···		···	
High	2.12	(1.28–3.51)	···		···	
Perceived benefits of sun protection						
High	1.39	(0.87–2.21)	···		···	
Medium-high	2.05	(1.16–3.60)	···		···	
Medium-low	2.05	(1.31–3.22)	···		···	
Low	1.00	Referent	···			
Wear sunscreen lotion†						
Never or rarely	···		1.92	(0.64–5.76)	···	
Sometimes	···		2.02	(0.65–6.30)	···	
Often or always	···		1.00	Referent	···	
Total hours spent outdoors‡						
0–8	···		1.00	Referent	···	
9–31	···		8.65	(2.80–26.74)	···	
32–42	···		3.82	(0.87–16.80)	···	
Know someone with skin cancer						
Yes	···		3.11	(1.16–8.34)	···	
No	···		1.00	Referent	···	
Sunbathed weekday or weekend						
Yes	···		···		2.03	(1.11–3.72)
No	···		···		1.00	Referent
Information about sun protection from family and friends						
Never	···		···		1.00	Referent
Few times per mo	···		···		2.00	(0.92–4.36)
Weekly	···		···		1.58	(0.74–3.35)
Almost daily	···		···		2.77	(1.35–5.65)

Ellipses indicate not included in final model.
* Odds ratios and CIs are adjusted for all other covariates in the final model and for complex sampling weights; final models consisted of variables significantly associated with the sunburn outcome or confounders.
† Frequency that sunscreen was worn when outside on a sunny day during the summer for more than 1 hour.
‡ Average total number of hours per week spent outdoors between 10 AM and 4 PM during the summer.

adolescents in the United States are sparse. Robinson et al[15] reported 1994 telephone survey data from 658 youths living in Chicago and rural Illinois; youths aged 11 to 19 had an average of 1.9 sunburns in the past year. Self-administered survey data from 506 Alabama middle school sixth graders suggest that summer sun exposure levels were high (average of 21 hours per week) with 82% reporting having had at least 1 summer sunburn.[16] Figures from the ACS Sun Survey are also consistent with data from the 1996 National Survey on Sun Exposure and Protective Behaviors in Canada, in which 36% of youths ages 15 to 24 were exposed to more than 2 hours of daily sun and 68% experienced at least 1 summer sunburn.[26] Among surveys conducted in Victoria, Australia, more than half of youths ages 5 to 13 had at least 1 sunburn and nearly 33% had 2 or more sunburns during 8 summer weeks[10]; 23% of youth ages 14 to 19 experienced at least 1 sunburn on a summer weekend.[9]

Some factors independently associated with sunburn among youths in this survey are similar to those reported in the literature, including higher sun sensitivity[9,10,14–16] and desirability of a tan.[16] White race was also an independent correlate of sunburn, in addition to sun sensitivity; all nonwhite racial groups were combined for the logistic modeling because of small sample sizes and lack of power to detect difference among these races. Odds of having received 1 to 4 summer sunburns were elevated for younger age groups. This finding is in general agreement with a previous study among 13- to 16-year-

olds[10] and another study of 12- to 17-year-olds[11] but not with another study of 11- to 19-year-olds[15] reporting null effects. The oldest age group, 16 to 18 years, was more likely to spend summer outdoor hours working paid jobs than participating in sports or recreational activities. Girls were more likely than boys to spend outdoor time sunbathing or swimming, but they spent less time outdoors overall. Similar findings have been previously reported.[15] Thus, youths who engaged in outdoor recreational activities may be more likely to expose themselves to intermittent sun exposure, which has been associated with increased risk of melanoma.[27,28] Knowing someone with skin cancer was correlated with reporting 5 or more summer sunburns, perhaps indicating a family history of skin cancer or membership in a community that has a high rate of UV exposure. An increased odds of past weekend sunburn associated with hearing frequent information about sun protection from family and friends in this cross-sectional study may reflect reverse causation, ie, the sunburn experience may have led family and friends to comment about sun protection.

Sunburn rates among US youths ages 11 to 18 as measured by this population-based telephone survey were high, which indicates that our youths are not effectively protecting themselves from the sun, despite our efforts to date. We also found that self-rated sun sensitivity varied substantially within and between race groups. This is especially important as the demographics of the United States continue to change toward a more heterogeneous mixture of racial and ethnic groups and an increase in population density in areas with high UV flux. Third, more than one third of youths reported having applied sunscreen with SPF 15+ before receiving their most serious summer sunburn. Clearly, if youths are getting their worst burns while using SPF 15 or greater sunscreens, then they are not using them correctly: it is too little, too late, inadequate coverage, inconsistent use, or failure to reapply. In addition to the SPF level of the sunscreen, the substantivity of the sunscreen used (eg, waterproof or very water resistant) may be important in this context because of the frequency of participation in recreational outdoor water sports. These issues may be responsible for at least some of the controversies regarding sunscreen use.[29–31] There is a real need for better education and awareness of proper use of these lotions to be accomplished through media/education-based programs as well as through the American Cancer Society "Slip!Slap!Slop!" message (SLIP! on a shirt, SLOP! on some sunscreen, and SLAP! on a hat). Fourth, programs designed to reduce sunburn and increase sun protection behaviors among middle and high school–age youths must take into account the developmental differences among youths and the context in which exposure occurs, including shaping the social norms to reduce the desirability of a tan and to increase the perceived benefits of protection. Fifth, sun safety interventions may be incorporated into other school-based health interventions (eg, physical activity programs for fitness and health). Effective programs will also address the physical environment of adolescents with regard to reducing harmful sun exposure, eg, providing shade structures at recreation areas and pools, increasing accessibility to sunscreen with an SPF of 15+, waterproof sunscreens and hats, and scheduling outdoor events before 10 AM or after 4 PM. Finally, water sports are an environment associated with a particularly important risk of intense exposure sufficient to cause sunburn, so this environment must be a focus of prevention efforts (eg, the Rhode Island Sun Smart project, which focused on summertime beach exposure).[23]

The ACS will use the results of this 1998 survey as a baseline measure for this critical age group as campaigns for sun protection are developed and implemented for youths. The survey will be repeated to track progress toward the 2015 goal and make course corrections in developing key messages for this critical age group. We believe that these data should be valuable to health care professionals who are interested in youth health promotion and health program planners evaluating effectiveness of school-based or community-based skin cancer education programs that are youth oriented. The ACS's goal for the year 2015 is to increase to 75% the proportion of people of all ages who practice 2 or more of the following protective behaviors to reduce skin cancer risk: avoid the sun between 10 AM and 4 PM, wear sun-protective clothing when exposed to sunlight, use sunscreen with an SPF of 15+, and avoid artificial sources of UV light. The ACS through the members of its coalition, the ACS Skin Protection Federation, and with many other organizations involved in the National Council on Skin Cancer Prevention, including the American Academy of Dermatology, the Skin Cancer Foundation, the Centers for Disease Control and Prevention, and the Environmental Protection Agency, are working together to deliver education about sun protection across a wide range of adult and youth populations in the United States.

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FINDING OLD CLASSMATES

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Summer Sunburn and Sun Exposure Among US Youths Ages 11 to 18: National Prevalence and Associated Factors

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