

Protection from Sun Exposure in US White Children Ages 6 Months to 11 Years

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SYNOPSIS

Objectives. To estimate the prevalence of protection from sun exposure among US white children ages 6 months to 11 years.

Methods. During the summer of 1998, using telephone directory lists supplemented by random-digit dialing, the authors surveyed parents living in the contiguous United States. They calculated weighted prevalence estimates for protection methods and conducted logistic regression analyses to determine parent and child characteristics predictive of protection behaviors.

Results. Parents of 1,055 white children were interviewed. Children spent a median of 20 hours per week outdoors during the summer, of which 10 hours were at school. Sunscreen (61.8%, 95% confidence interval [CI] 57%, 66%) and shade (26.5%, 95% CI 22%, 31%) were the most frequently reported protection methods. Parents reported higher rates of protection for younger children and children who sunburn easily.

Conclusions. Parents report that a large proportion of white children is protected from sun exposure by one or more methods. Health care providers and educators might encourage the use of all methods of protection, not just sunscreen use, and educate older children to protect themselves from the sun.

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Skin cancer is the most common cancer in the United States, exceeding one million cases in 2000.^{1,2} Risk factors include family history of skin cancer, fair skin, sun-sensitive skin, and excessive sun exposure, particularly early in life.³⁻⁶ To prevent skin cancer, experts recommend staying out of the midday sun, finding shade when outdoors, wearing protective clothing, and applying sunscreen with a sun protection factor (SPF) of 15 or higher.¹

In interviews of parents, at least 50% of children were reported to wear sunscreen in the sun.⁷⁻¹² Other protection methods reported were avoidance of midday sun (55%–71%); seeking shade (12%–51%); and wearing shirts or protective clothing (8%–48%) and hats (3%–27%).^{7-9,12} Unfortunately, few of these previous studies used population-based samples or obtained estimates of time children spent outdoors.^{8,9,12} We surveyed parents to estimate the prevalence of protection from sun exposure among children and the time children spend outdoors, and to identify factors associated with protection methods.

METHODS

Sampling methods

The target population for this survey was parents, guardians, or primary caregivers (hereafter referred to as “parents”) of children ages 6 months to 11 years. Parents were recruited by contacting households in the contiguous United States that had telephones.¹³

Fax, computer, and cell phone numbers form a growing proportion of telephone numbers, rendering random-digit dialing less and less efficient for contacting individual persons and making directory lists a reasonable alternative. We used both options: one list of telephone numbers contained directory-listed households and the other contained random-digit dialing numbers selected from all numbers not directory-listed, and for states (California and Nevada) with low rates of directory-listed numbers.¹³

We had to complete 1,125 interviews to achieve 80% power to test the hypothesis that there was no difference in protection between sun-sensitive and non-sun-sensitive white children, and to determine the prevalence of protection from sun exposure in white children.

Of the 21,328 telephone numbers in the sample, we subtracted 4,002 nonworking numbers and 10,902 ineligible households, leaving a total of 6,424 numbers. Of these, 3,651 numbers exceeded the 12-call attempt limit, 923 numbers resulted in hang-up or hostile response, and 564 parents refused to participate. A total of 1,286 parents were interviewed success-

fully. We calculated lower-bound response rates of 48.9% to 54.7%, based on estimated percentages (17% and 11%) of eligible households that could have been in the study but were not interviewed, among the 4,574 households that could not be screened.¹³ Seventeen percent of households were estimated to be eligible, and 66% of telephone numbers were estimated to be working ($66\% \times 17\% = 11\%$). For households with more than one eligible child, the child with the most recent birthday was selected to be the subject of the interview.

Of the 1,286 parents interviewed, 1,055 had white children, 110 had African American children, and 121 had children of other races. Children of Hispanic origin were classified according to their race. Although the number of non-white children was small, we report our findings for this group because so little information exists on their protection from sun exposure.

Questionnaire

The questionnaire was pretested and administered by a computer-assisted telephone interviewing system during the summer of 1998. There were two main sections: the first administered to all parents; the second, only to parents of white children.

The first section elicited age, gender, and race of the child; number of hours spent outdoors in a typical week; and how often the child went out in the sun between 10 a.m. and 4 p.m. Parents were asked: “When [child’s name] goes outside on a sunny day for more than one hour, how often does he/she . . . wear a wide-brimmed hat with a brim all around, wear protective clothing such as long-sleeved shirts or long pants, stay in the shade or under an umbrella, wear sunglasses, apply or wear sunscreen or sun block?” The response categories included *always*, *often*, *sometimes*, *rarely*, and *never*. In the analyses, *often* and *always* responses were combined as “frequent uses.” *Sometimes*, *rarely*, and *never* responses were combined as “infrequent uses.”

The second section of the questionnaire elicited the child’s hair and eye color and skin reaction to sun exposure after several months of not being in the sun and after repeated exposure. Questions regarding parent characteristics included demographic and socioeconomic information.

A subset of parents with white children who ever wore sunscreen, clothing, or hats was asked additional questions about sunscreen use, body coverage by clothing, and type of hats worn.

A UV index was calculated from the household’s telephone area code overlaid on a UV index map created by the US National Oceanic and Atmospheric Administration (personal communication, Craig Long,

National Oceanic and Atmospheric Administration; October, 1998). The contiguous United States encompasses UV index levels 6 (moderate exposure) through 11 (high exposure).

Data analyses

To compute generalizable estimates, we used sampling weights that accounted for the variable sampling fractions of households; nonresponse; and the sample distribution of race, age, and gender of the children with a poststratification adjustment factor.¹³

We calculated prevalence and 95% confidence intervals (CI) for the protection methods used. To test for associations between protection methods and parent and child characteristics, chi-square analyses were conducted. To determine the most important factors associated with protection, variables that were associated at the $p \leq 0.1$ level in the univariate analyses were included in the multivariate logistic regression analyses.¹⁴ Parental education was included in modeling as an indicator for socioeconomic status. A stepwise, backward elimination procedure was used, and variables were retained at the $p < .05$ level. All analyses were conducted with SUDAAN¹⁵ (Release 6.40) and adjusted for the sampling design.

RESULTS

Study population

Among the parents of the 1,055 white children, most were the child's mother (839, or 79.5%) or father (170, 16.1%); 46 (4.4%) were guardians, grandparents, other relatives, or foster parents. The sample included 524 boys and 531 girls, whose average age was 6.5 years. (Information for the 231 non-white children is presented at the end of the Results section.)

Time spent outdoors

Sixty-four percent of children frequently went out on sunny days for more than one hour between 10 a.m. and 4 p.m. ($n = 701$, 63.9%, 95% CI 59.5%, 68.3%). During the summer, children spent a median of 20 hours per week outdoors. Of that time, a median of five hours was spent at day care ($n = 198$), 10 hours at school ($n = 200$), and five hours at other organized outdoor activities ($n = 372$). Children who lived in regions with a higher UV index, such as the South, spent less time outdoors per week in the summer than children who lived in regions with a lower UV index (median of 12 hours per week for region 10 or higher versus 21 hours for regions 6 and 7). During the winter, children spent a median of seven hours outdoors per week.

Table 1. Protection from sun exposure in US white children ages 6 months to 11 years ($n = 1055$), 1998

Method ^a	Protection from sun exposure		
	Number	% ^b	95% CI ^b
Sunscreen	667	61.8	57.3, 66.2
Shade	251	26.5	22.4, 30.5
Sunglasses	127	12.8	9.8, 15.8
Protective clothing	69	9.3	6.3, 12.3
Wide-brimmed hat	75	8.3	5.7, 11.0

^a Method used *always* or *often* when outside for more than one hour on a sunny day.

^b Weighted estimates

CI = confidence interval

Protection from sun exposure

Sunscreen was the most commonly used method of protection (Table 1); use of other protection methods was substantially lower.

Several parental and child characteristics were associated with protection methods used (Table 2). For the parents, significant relationships were found between younger age and use of shade, being married and use of sunscreen and use of ≥ 1 method, and lower socioeconomic status (education and income) and use of shade.

Younger children and children who sunburned easily were more frequently protected than older children or those who tanned easily (Table 2). Children who spent more time outdoors were less frequently protected than children who spent less time outdoors.

Protection from sun exposure was not associated with the child's gender or the UV index of residence (Table 2), or with the number of children in the household, Hispanic origin, or hair or eye color (data not shown).

Multivariate logistic regression analyses indicated that the most important predictors of the use of sunscreen, shade, or any of the protection methods were the child's skin sensitivity to sun exposure and the child's age (Table 3).

Levels of protection from sun exposure among subsets of children using protection

Among the children who wore sunscreen, almost all used the recommended SPF of at least 15 (Table 4). For most children, sunscreen was applied just before going outdoors; in about half, sunscreen was often reapplied after spending time in water.

Among the children who wore some type of hat,

Table 2. Protection from sun exposure in US white children ages 6 months to 11 years (n = 1,055), by parent and child characteristics, 1998

	Number ^b	Protection from sun exposure ^a		
		Sunscreen Percent ^c	Shade Percent ^c	One or more methods ^d Percent ^c
Parent characteristics				
Sex				
Male	178	59.0	20.8	6.4
Female	875	62.6	27.5	76.6
Age (years)				
18–30	217	67.4	37.3	80.8
31–35	238	63.8	26.1	75.3
36–40	289	62.2	20.0	75.0
41 or older	304	54.6	22.1 ^e	67.9
Marital status				
Married	889	64.7	27.6	78.0
Not married	164	50.3 ^e	22.0	62.5 ^e
Education				
High school/less	312	55.3	30.4	69.2
Vocational school or 1–3 years college	321	62.3	31.8	75.1
College graduate	422	68.0	18.2 ^e	80.3
Income				
\$30,000 or less	245	58.8	35.5	76.8
\$30,001–50,000	273	60.0	25.0	70.1
\$50,001 or more	444	64.7	21.9 ^e	75.7
Family or friend ever had skin cancer				
Yes	426	64.7	27.4	79.2
No	612	61.5	25.4	72.4
Child characteristics				
Sex				
Male	524	61.7	27.8	75.5
Female	531	61.8	25.0	74.1
Age (years)				
<2	113	69.1	47.5	88.9
2–3	182	77.6	34.3	88.1
4–5	186	69.4	28.3	79.6
6–7	167	58.4	22.7	71.3
8–9	220	55.1	19.3	70.6
10–11	187	44.5 ^e	12.8 ^e	55.1 ^e

(continued)

more than three quarters wore baseball caps or sun visors (Table 4). Substantially fewer wore wide-brimmed hats shading face, nose, and ears; hats with neck drapes; or bonnets or other hats.

Among the children who ever wore protective clothing ($n = 502$), the trunk was the body area most often covered (80.4%), followed by the feet (35.9%), legs

(35.2%), head (30.7%), arms (28.9%), and neck (17.3%) (data not shown). The categories for body area covered were not mutually exclusive.

Protection from sun exposure in non-white children
African American children spent a median of 12 hours per week outdoors in the summer; children of races

Table 2 (continued). Protection from sun exposure in US white children ages 6 months to 11 years (n = 1,055), by parent and child characteristics, 1998

	No. ^b	Protection from sun exposure ^a		
		Sunscreen Percent ^c	Shade Percent ^c	One or more methods ^d Percent ^c
Skin sensitivity with				
1 hour sun exposure				
Severe sunburn	415	72.6	30.5	87.6
Mild sunburn, some tanning	414	61.1	24.2	72.1
Tan, no sunburn	217	42.1 ^e	22.6	55.6 ^e
Skin sensitivity with				
repeated sun exposure				
Repeated sunburns, freckles, no tan	319	71.7	34.1	86.6
Mild tan	219	68.7	36.5	77.8
Moderate tan	280	52.7	21.1	68.2
Deep tan	203	50.0 ^e	14.9 ^e	62.3 ^e
Summer time spent				
outdoors (hours)				
<10	210	6.9	41.4	85.3
10–19	308	64.2	26.6	77.8
20–29	275	54.7	18.6	64.4
30 or more	254	62.3	20.0 ^e	72.9 ^e
UV index region				
of residence ^f				
6 or 7	253	60.0	20.9	70.0
8	433	65.4	26.2	77.3
9	289	59.0	31.7	73.5
10+	80	59.1	24.0	80.5

^a Method used *always* or *often* (compared to *sometimes*, *rarely*, or *never*) when outside for more than one hour on a sunny day.

^b Some items do not add to 1,055 because of missing information.

^c Weighted percent

^d Use one or more of the following: sunscreen, shade, hat, protective clothing, or sunglasses.

^e Chi-square test significant at $p \leq 0.05$ (trend for ordinal variables).

^f The contiguous US is within UV index regions 6 to 11.

other than white or African American spent a median of 14 hours outdoors. Both groups of non-white children spent a median of seven hours per week outdoors in the winter. About 19% of African American children and almost half of the other non-white children frequently went outside for more than one hour on a sunny day between 10 a.m. and 4 p.m. (Table 5).

Among African American children, the rate of sunscreen use was low (12.1%) (Table 5). Other non-white children, however, wore sunscreen more than half the time. A lower rate of staying in the shade was also reported for African American children (21.9%) than for other non-white children (30.4%). Other pro-

tection methods had low rates and unstable estimates (data not shown).

DISCUSSION

This study indicates that white children spend considerable time outdoors, often when the sun's rays are the strongest. Overall prevalence of some type of protection from sun exposure was high, and sunscreen was the preferred protection method. Protection was higher for younger children and those who sunburned easily than for older children or those who tanned well.

It is generally thought that individuals receive a

Table 3. Odds of protection from sun exposure in US white children ages 6 months to 11 years in relation to parent and child characteristics, 1998

	Protection from sun exposure ^a					
	Sunscreen ^b		Shade ^b		One or more methods ^{b,c}	
	OR	95% CI	OR	95% CI	OR	95% CI
Parent marital status						
Married	1.00		1.00		1.00	
Not married	0.62	0.37, 1.06	0.64	0.35, 1.15	0.50	0.27, 0.90
Parent education						
High school or less	1.00		1.00		1.00	
1–3 years college or vocational school	1.30	0.79, 2.14	0.94	0.55, 1.60	1.27	0.73, 2.21
4+ years college	1.45	0.89, 2.37	0.38	0.23, 0.64	1.41	0.84, 2.37
Child age (years)						
<2	1.00		1.00		1.00	
2–3	2.19	0.95, 5.01	0.59	0.28, 1.28	1.67	0.58, 4.83
4–5	1.62	0.68, 3.86	0.50	0.24, 1.07	0.90	0.31, 2.57
6–7	0.79	0.34, 1.82	0.38	0.18, 0.83	0.42	0.16, 1.12
8–9	0.80	0.36, 1.76	0.27	0.12, 0.58	0.47	0.18, 1.25
10–11	0.53	0.23, 1.22	0.18	0.08, 0.42	0.24	0.09, 0.65
Child skin sensitivity with one hour sun exposure						
Tan, no sunburn	1.00		1.00		1.00	
Mild sunburn	2.23	1.36, 3.6	1.16	0.62, 2.15	2.08	1.23, 3.51
Severe sunburn	3.16	1.80, 5.55	1.10	0.57, 2.14	4.54	2.40, 8.44
Child skin sensitivity with repeated sun exposure						
Deep tan	1.00		1.00		1.00	
Moderate tan	0.88	0.49, 1.58	1.41	0.68, 2.90	0.95	0.53, 1.70
Mild tan	1.76	0.96, 3.22	2.63	1.25, 5.53	1.46	0.74, 2.85
Repeated sunburns	1.61	0.85, 3.04	2.32	1.12, 4.79	2.12	0.99, 4.57

^aOdds of using protection method *always* or *often* (compared to *sometimes*, *rarely*, or *never*) when outside for more than one hour on a sunny day.

^bEach model adjusted for all factors listed in first column.

^cUse one or more of the following: sunscreen, shade, hat, protective clothing, or sunglasses.

OR = odds ratio

CI = confidence interval

large amount of their lifetime sun exposure during childhood.¹⁶ Even among children, younger ones may receive more sun exposure than older ones.¹⁷ Such early sun exposure may be reflected in the incidence of melanoma. For example, melanoma among women in their 20s is higher than the incidence of the most common adult cancers, such as breast, lung, or colorectal cancer.¹⁸ Some of the children's sun exposure may occur during day care, school, or other activities where children are not under parental control and protection from sun exposure may be limited.¹⁹

Our prevalence estimates of protection from sun

exposure are similar to those of some previous studies;^{7,8} but other studies estimated higher protection of children at the beach.^{9,11,12} We did not assess protection during specific activities, and this aspect of sun protection needs further study.

The high prevalence of sunscreen application may reflect its ease of use and industry promotion. Most respondents reported using sunscreen with the minimum recommended SPF of 15; a lower proportion of respondents reported proper sunscreen use, such as reapplication after being in the water or application 30 minutes before going outside. Additional educa-

Table 4. Levels of protection from sun exposure in US white children ages 6 months to 11 years, 1998

	Levels of protection from sun exposure		
	Number ^a	Percent ^b	95% CI ^c
Use of sunscreen ^d (n = 1,005)			
Sun protection factor used			
SPF <15	25	3.2	1.5, 4.8
SPF ≥15	952	96.9	95.2, 98.5
Application when going outside			
30 minutes before	207	19.0	15.6, 22.5
Just before	655	66.8	62.4, 71.2
Within 15 minutes after	96	9.5	6.7, 12.4
More than 15 minutes after	40	4.7	2.1, 7.2
Reapplication after swimming			
Often	522	53.4	48.8, 58.0
Sometimes	273	26.2	22.2, 30.1
Rarely	98	9.6	6.9, 12.3
Not necessary (waterproof)	23	2.4	1.2, 3.7
Use of hats ^a (n = 565)			
Type of hat			
Baseball cap or sun visor	443	77.7	72.6, 82.9
Wide-brimmed hat shading face, nose, ears	82	14.2	10.1, 18.4
Hat with neck drape	12	2.2	0.6, 3.9
Bonnet or other	25	5.8	2.4, 9.1

^a Numbers may not add to total number of children protected by method due to missing responses.

^b Weighted estimates

^c Children not protected by this method are excluded.

CI = confidence interval

tion on the proper use of sunscreen may be needed. It is important to note, however, that although sunscreen may be very effective in preventing sunburn, scientific evidence that sunscreen use will prevent skin cancer is limited.^{20,21} Therefore, protection methods other than sunscreen are important but are used to a lesser extent.

High use of protection measures does not necessarily imply complete coverage of the skin. For example, Olson and associates found that only 54% of children at the beach were fully covered by some means of protection, and, as in our study, 17% were not covered on any region of the body.⁹ Mayer and colleagues

Table 5. Protection from sun exposure in African American and other non-white children ages 6 months to 11 years, 1998

Method ^a	Protection from sun exposure					
	African American (n = 110)			Other non-whites (n = 121)		
	Number	Percent ^b	95% CI ^{b,c}	Number	Percent ^b	95% CI ^{b,c}
In sun 10 a.m. to 4 p.m.	37	18.5	10.3, 26.7	53	48.4	34.2, 62.6
Sunscreen	20	12.1	3.8, 20.4	53	53.2	39.4, 67.1
Shade	29	21.9	11.7, 32.2	31	30.4	17.4, 43.4

^a Method used *always* or *often* when outside for more than one hour on a sunny day

^b Weighted estimates

^c CI = confidence interval

concluded that reported use of sunscreen and protective clothing may not have been effective as measured by colorimeter of the skin.²² We found that, among children who wore hats, a high proportion wore baseball caps, which do not shade the ears, sides of the face, or neck.

The reasons older children received less protection may be related to their increasing independence from parental control. This suggests that interventions are needed to help parents and children use adequate protection and, as children become more independent, to understand the importance of protection.²³

Our results confirm that children who sunburn easily are better protected than less sensitive children.^{7,24} Parents and children may learn from previous sunburn experiences to use protection, yet 12% of the very sensitive children were not protected at all. Parents and children may not have recognized the need for protection to prevent more serious health consequences, or parents may not have recognized that their children were highly sun-sensitive.²⁵

One possibly important conduit for education and intervention may be school-based activities, including provision of shade structures, policies for protection during recess and sports activities, and curricula that teach protection.²⁶ Other conduits for intervention may include community organizations; for example, a survey of YMCAs found that few offer protection or include sun safety education in swim classes.²⁷

Few studies have assessed protection from sun exposure in African American or other non-white populations.^{7,28} Robinson and colleagues reported higher rates of protection than we found in African American and other non-white children.⁷ However, these results should be interpreted with caution because of the low number of non-white participants in the studies. Although skin cancer rates are substantially lower among non-white populations,¹ about 6% of African Americans report that they sunburn easily,²⁸ a risk factor for skin cancer among whites.³ This population may benefit from education about protection methods. Future research needs to over-sample non-whites to adequately assess protection practices and sunburns among these population groups.

The strengths of this study include its population-based sample and the wide variety of information collected. Its limitations include the low response rate (74% of working telephone numbers were successfully screened and 70% of known eligible respondents were interviewed), which is comparable to those of other telephone surveys. All such surveys are experiencing tremendous difficulty achieving high response rates, and many have reported declining response rates.²⁹⁻³¹

Methodologic studies that have introductory language about the legitimacy of the study, an increased number of call attempts per telephone number, and financial incentives for respondents have achieved some improvement in response rates. Yet increasing the number of call attempts to 22 did not achieve a response rate higher than 62%.³⁰ As with other studies, the response rates may limit the representativeness and generalizability of results.

Another limitation of this study is that the level of protection was not directly observed, and therefore related questions carried potential for socially acceptable responses. The time children spent outdoors was estimated by parents, and likewise was not directly observed; however, another study²² found that similar parental reports correlated closely with colorimetric assessment of the children's skin color, suggesting that outdoor time may be reported fairly accurately by parents. Finally, our results may not be generalizable to Puerto Rico or Hawaii.

In summary, protection from sun exposure is reported for a high proportion of children. Further public health interventions may increase protection for children with high skin sensitivity to the sun and for older children and may educate the public about alternatives to sunscreen. Interventions that modify the environment (e.g., provision of shade structures) may also warrant further attention.

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