Research Article

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Sun Protection Practices and Sun Exposure among Children with a Parental History of Melanoma

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Abstract

Background: First-degree relatives of melanoma survivors have a substantially higher lifetime risk for melanoma than individuals with no family history. Exposure to ultraviolet radiation (UVR) is the primary modifiable risk factor for the disease. Reducing UV exposure through sun protection may be particularly important for children with a parental history of melanoma. Nonetheless, limited prior research has investigated sun protection practices and sun exposure among these children.

Methods: The California Cancer Registry was used to identify melanoma survivors eligible to participate in a survey to assess their children's sun protection practices and sun exposure. The survey was administered by mail, telephone, or web to Latino and non-Latino white melanoma survivors with at least one child (0–17 years; $N = 324$).

Results: Sun exposure was high and the rate of sunburn was equivalent to or higher than estimates from average-risk populations. Use of sun protection was suboptimal. Latino children were less likely to wear sunscreen and hats and more likely to wear sunglasses, although these differences disappeared in adjusted analyses. Increasing age of the child was associated with lower sun protection and higher risk for sunburn, whereas higher objective risk for melanoma predicted improved sun protection and a higher risk for sunburns. Perception of high barriers to sun protection was the strongest modifiable correlate of sun protection.

Conclusions: Interventions to improve sun protection and reduce sun exposure and sunburns in high-risk children are needed.

Impact: Intervening in high-risk populations may help reduce the burden of melanoma in the United States. *Cancer Epidemiol Biomarkers Prev; 24(1); 169–77. ©2015 AACR.*

Introduction

Melanoma is the most serious form of skin cancer with rates of the disease rising rapidly over the past several decades (1, 2). Melanoma is one of the top 10 most common cancers among non-Latino whites (3). Although most prevalent among whites, recent data suggest that rates are increasing among Latinos (4). In addition, several studies have found that Latinos may be more likely to be diagnosed with late-stage disease (5, 6), providing further justification for their inclusion in skin cancer prevention efforts.

Sun exposure is the primary modifiable risk factor for melanoma, with childhood estimated to be one of the most critical exposure periods for conferring risk (7–9). Children of melanoma survivors are at substantially increased risk for melanoma (8–12 fold increase estimated in prior studies), due to a confluence of factors including inherited predisposition, shared phenotypic characteristics, and common high-risk sun exposure patterns (10–13). The relative contribution of these factors to lifetime melanoma risk is not well understood. Despite the uncertainty, the American Cancer Society, the NCI, and the American Academy of Dermatology agree that individuals with a family history of melanoma should, at a minimum, be urged to follow existing population-level recommendations for reducing skin cancer risk. Existing recommendations suggest UVR exposure in children should be prevented or reduced through the use of protective clothing (e.g., shirts with sleeves, hats, sunglasses), sunscreen with a SPF > 30, and by limiting time in the sun, particularly during the peak sun hours of 10 am to 4 pm (14–19).

Despite the increased risk status of children of melanoma survivors and the potential harm of sun exposure early in life, relatively little prior research has studied this population. Most prior studies with high-risk samples have focused on adult first-degree relatives of melanoma survivors, particularly siblings (20, 21). They have generally observed inadequate use of sun protection overall with sunscreen use most common and use of other prevention strategies infrequent (20, 22). Geller and colleagues published one of the few studies focused on children with a family history of skin cancer, finding that although reported use of sunscreen was higher among children with a maternal history of skin cancer (either melanoma or nonmelanoma skin cancer) compared with children with unaffected mothers, these children were more likely to have experienced a recent sunburn (23). In a small study, Glenn and colleagues (2012) found that melanoma survivors reported a slightly higher level of sun protection for their children than previously observed in research with average risk children, finding that 79% of children of melanoma survivors reported that their

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child routinely uses sunscreen (24), compared with only 65% to 75% adherence observed in recent studies with non–high-risk samples of children (25, 26). However, sunburns were common with 49% of melanoma survivors reporting their child had a sunburn in the past year (24). In a recent study, Gritz and colleagues (2013) found that children of melanoma survivors (12 years of age or younger, 99% non-Latino white) recruited through the University of Texas MD Anderson cancer registry utilized sunscreen and protective clothing only "sometimes" or less frequently and over a quarter of children (28%) had experienced a recent sunburn according to parent report (27). The primary purpose of the current study was to assess use of sun protection practices, typical sun exposure, recent sunburn history, and modifiable correlates of these outcomes in a population-based sample of children of melanoma survivors in California. The inclusion of Latino children with a parental history of melanoma is a novel contribution to the field, given their infrequent inclusion in prior research.

Materials and Methods

Recruitment and data collection procedure

Contact information was obtained from the California Cancer Registry (CCR) for melanoma survivors who met the following criteria: 18 to 50 years of age at the time of diagnosis, alive according to CCR records, and Latino or non-Latino white ethnicity. We requested a random sample of non-Latino white survivors diagnosed during 2007–2009, given the limited scope of the study and relatively large number of total cases diagnosed in the state (19, 393 melanomas diagnosed between 2007 and 2009 in non-Latino whites). To facilitate ethnic comparisons, and given the substantially lower incidence of melanoma among Latinos compared with non-Latino whites (4.6 per 100,000 vs. 33 per 100,000 during the study period; ref. 28) this group was oversampled by requesting contact information for all Latino survivors diagnosed within a wider time frame (2005–2009; total Latino cases diagnosed between 2005 and 2007 = 17,94) than non-Latino whites (28). In addition to the criteria listed above, survivors needed to meet the following additional criteria that could only be ascertained after further contact: English or Spanish speaking and parent of a biologic child <17 years of age. If a respondent had more than one child within the target age range, parents were asked to provide data about the two youngest children. These individuals completed the 27 child-specific survey items twice. The analytic sample for the current study is restricted to one child per respondent given the correlation between responses for individual children from the same parent (intraclass correlation = 0.57). In instances when parents reported on two eligible children, we selected the child within or closest to the age range of 5 to 10 years, because one of the purposes of this study was to inform future intervention efforts. We anticipated that our future intervention efforts would focus on children between the ages of 5 to 10 years because children of this age are increasingly involved in activities that may put them at risk for sun exposure yet are still under the care of their parents, making parent-focused interventions appropriate (29).

Data collection took place between the fall of 2010 and the summer of 2012. Before initiating contact with the survivors, a letter was sent to each survivor's physician informing him or her of the study and our plan to contact the survivor. Physicians were asked to contact us within 2 weeks if they did not believe the survivor should be contacted and provide their rationale. Only four physicians responded to our notification letter asking us not to contact their patients. The initial mailing sent to survivors included a cover letter that explained the study and eligibility criteria, an information sheet that contained all elements of informed consent, a pamphlet about CCR, and the eligibility screener and survey. Mailings to Latino participants included all study documents in English and Spanish. Participants were instructed to complete the eligibility screener and, if interested and eligible, to complete and return the mailed survey in the self-addressed stamped envelope. Participants were also given the option to complete a web-based or telephone version of the survey. About 2 weeks after the invitation mailing, telephone contact was initiated with survivors who did not respond to our mailing to indicate interest or decline participation. Up to 5 to 7 telephone calls were made for each participant at various times of the day and week to enhance the probability of reaching survivors. After completing the survey, participants were mailed a $20 gift card. Although we attempted to collect data directly from the survivor, we allowed the child's other parent (survivor's spouse) to complete the survey. An item on the survey inquired as to whether the survey respondent was the melanoma survivor or the child's other parent. This study was approved by the Institutional Review Boards of the University of California, Los Angeles (Los Angeles, CA) and the California Committee for the Protection of Human Subjects.

Survey instrument

Items that comprised that survey instrument were drawn primarily from the prior work of the research team having undergone extensive pretesting with demonstrated adequate psychometric properties (30–33). Development of the survey was further guided by the Health Behavior Framework, which posits that the likelihood of performing a health behavior at the individual level is influenced by a confluence of factors at the level of the individual, at the level of the health care system, and within the larger societal context (34). The Health Behavior Framework represents a synthesis of some of the major theoretical formulations in the area of health behavior, such as Social Cognitive Theory (35, 36), the Health Belief Model (37, 38), the Theory of Planned Behavior (39–43), the Transtheoretical Model of Change (44, 45), and Social Influence Theory (46–48). The Framework was designed to be broad to depict the multitude of influences on health behavior beyond what is typically measurable in most health behavior studies (i.e., individual level factors). Consistent with the nature of the study, the survey focused mainly on assessing children's sun protection practices and potential determinants of these practices. Given the role of parents in ensuring their child is adequately protected from the sun, the data collection instrument primarily assessed potential determinants of sun protection at the parent level. The survey ranged from 109 to 136 items depending on the number of eligible children and was pilot tested before it was finalized for use in this study (24).

Sun protection practices. The survey included items that assessed use of sun protection strategies by respondents for themselves as well as for their children. Values were assigned on the basis of

frequency of use of five sun protection strategies when outside on a sunny day: sunscreen, wearing shirts with sleeves, wearing hats, wearing sunglasses, and seeking shade when outside (1 = never/rarely, 2 = sometimes, 3 = often, and 4 = always; ref. 32). The values were averaged to create a mean "sun protection composite" score for each child and each parent. For analyses focused on individual sun protection practices, responses were dichotomized into two categories: 1, often/always; 2, never/rarely/sometimes.

Recent sunburn. One item asked parents to report whether or not their child had experienced a sunburn (i.e., reddening of the skin that lasts until the next day) within the past 12 months. Parents were also asked if their child had ever received blistering sunburn (31).

Mean hours of UV exposure during peak period. One item asked parents on average how many hours their child is outside per day between 10 am and 4 pm on weekends in the summer (32).

Correlates of sun protection practices and sunburn

Demographics. A series of items assessed demographic characteristics including education, age, gender, ethnicity, total household income, and health insurance coverage for the respondent as well as for eligible children.

Melanoma history. Two items were used to assess family history of melanoma. Participants were initially asked whether they had additional melanoma diagnoses in the family (other than the case). If they responded "yes," they were asked to indicate the number of additional diagnoses and provide information about the relationship of the additional case to the eligible child. Stage at diagnosis was extracted from CCR records. Time since the diagnosis (in months) was calculated by subtracting the date of diagnosis based on CCR records from the data of survey completion.

Objective risk of the child. A modified Fitzpatrick (49) scale was used to develop a "risk score" for each child based on parent report of the following characteristics: skin color, hair color, eye color, and the skin's reaction to one hour of sun exposure. Values were assigned for each response (1–4) and then summed for each child with higher values reflecting greater sun sensitivity.

Perceived severity of melanoma. One item assessed the perception of the parent regarding the severity of melanoma, ranging from 0 (not serious) to 10 (extremely serious; refs. 31, 50).

Perceived risk of melanoma (compared with other children). One item asked parents if they think their child is "more likely," "less likely," or has the "same chance" of developing melanoma compared with other children (31, 50).

Perceived efficacy of sun protection. Adult respondents were asked to rate the effectiveness of the following five sun protection strategies in reducing melanoma risk: use of sunscreen, use of full-length clothing, use of hats, seeking shade to avoid sun exposure, and staying indoors (31, 50). Effectiveness was rated on a scale from 0 (not effective) to 10 (extremely effective) and responses to the five items were averaged to create a mean for each respondent with a range of 0 to 10.

Perceived barriers to sun protection. Parents were asked to rate the following barriers to sun protection: difficultly keeping a hat on your child, child protests sunscreen use, child complains about wearing full-length clothing, sunscreen is expensive, summer heat discourages use of full-length clothing on child, staying in the shade excludes the child from participating in activities other children can do (31). Response options were "strongly agree," "somewhat agree," "somewhat disagree," and "strongly disagree." Respondents received one point if they indicated they "strongly" or "somewhat agree" with the barrier and no points if they responded "strongly" or "somewhat disagree." A summary score was created for each respondent by adding responses to the 6 barrier items with a higher score reflecting more barriers to sun protection and a range of 0 to 6.

Social norms regarding sun protection. Summary score was created on the basis of the reported proportion of family and friends who use sunscreen, wear hats, prefer outdoor summer activities, hold positive attitudes toward tanning (reverse scored), avoid outdoor activities midday, wear full-length clothing when outside in summer (30, 31). Participants were asked to respond "mostly true" or "mostly false" to each of the 6 social norm item. Respondents received one point for each response that reflected supportive social norms for sun protection. A summary score was created for each respondent with higher scores reflecting more supportive social norms and a range of 0 to 6.

Melanoma-related knowledge. Parents were asked to distinguish whether the following risk factors increased, decreased, or made no difference in a person's risk of getting melanoma: having moles, freckles, naturally dark skin, frequent tanning, tanning easily, getting a lot of sunburns as a child and as an adult, using sunscreen regularly, and having a family history of skin cancer (30, 31). Respondents received one point for each correct answer and a summary score was created from these nine items with a higher score reflecting greater knowledge and a range of 0 to 9.

Data analysis

Descriptive statistics were used to characterize the sample demographics of parents and their children, sun protection, UV exposure and sunburn frequency as well as potential additional correlates of these outcomes (i.e., melanoma history, parental psychosocial factors). Two-sample t tests for categorical variables and Spearman rank correlation tests for continuous variables were used to conduct bivariate analysis of factors associated with sun protection composites. χ^2 tests for categorical variables and t tests for continuous variables were applied to analyze the bivariate associations between potential correlates and individual sun protection practices and sunburn history, which were both categorical outcomes. Factors associated in bivariate analyses at the $P \leq 0.10$ level were included in the multivariate analyses using logistic (individual sun protection practices, sunburn history) or linear regression (sun protection composite). Statistical significance was assessed at the 0.05 level for multivariate analyses. Data were analyzed using SAS for Windows version 9.3 (SAS Institute, 2011).

Results

Outcome of recruitment

We initiated contact with 1,820 survivors including 1,248 non-Latino whites and 572 Latinos. Of the 1,820 survivors, 683 (37.5%) completed the eligibility screener. The most common reasons for noncompletion of the eligibility screener were inability to make contact with a survivor due to invalid contact information (50% of those not screened), never reaching a survivor after multiple calls (39%) and survivor refusal to be screened (9%). Of the 683 survivors who completed the screener, 336 were found to be eligible and enrolled in the study (49% of those screened for eligibility). The most common reason for ineligibility was not having an age-eligible child (97% of ineligible). Seven respondents were eliminated from the final sample because they self-reported an ethnicity other than Latino or non-Latino white. In addition, five respondents were eliminated due to missing child age. The final analytic sample included 324 children (271 non-Latino white; 53 Latino). The most common method of providing data was by mailed survey (66% of respondents) with a smaller proportion selecting the web-based (26%) or telephone survey (8%). Only 4% of the sample opted to complete the survey in Spanish. Although the non-survivor parent was given the opportunity to complete the survey on behalf of their child, 98% of surveys were completed by the parent who was the melanoma survivor.

Sample characteristics

Table 1 displays information about the final sample of 324 parental respondents and the 324 children for which these respondents provided data. The respondent sample was comprised primarily of non-Latino whites (84%) and was mostly female (70% female). Mean age of respondents was 42 years and the sample was relatively advantaged with regard to education level and income. The average age of children in the analytic sample was 9 years and 49% of children were female. Most survivors were diagnosed with early-stage melanoma 41 months before the survey on average. Latino survivors, who comprised 16% of the sample, differed from non-Latino white survivors on numerous demographic factors (data not in table). For example, Latino survivors were slightly younger (41 vs. 43 years), reported lower levels of education and income, and

Table 1. Sample characteristics and melanoma knowledge, beliefs, and barriers of parents

Variable	Categories	% (*N*)
Sample characteristics		
Characteristics of parent/respondent ($n = 324$)		
Mean age (SD)	Range (26–52 years)	42.3 years (6.02)
Sex	Female	69.75 (226)
Ethnicity	Non-Latino white	83.64 (271)
	Latino/Hispanic	16.36 (53)
Parent education level	Less than college degree	38.89 (126)
	≥College graduate	61.11 (198)
Total household income	<$50,000	14.68 (43)
	$50,000–$100,0000	30.72 (90)
	>$100,0000	54.61 (160)
Stage at diagnosis	*In situ*	27 (89)
	Stage 1	65 (212)
	All others	7 (23)
Average time since diagnosis (SD)	Range (17–76 months)	41.22 months (SD = 10.36)
Current status of cancer	Completed treatment	95.99 (311)
Family history of melanoma	2 or more diagnoses	29.91 (96)
	1 diagnosis in family	70.09 (225)
Health insurance status	Any public or private	97.21 (314)
Characteristics of selected child ($n = 324$)		
Mean age (SD)		9.19 years (4.43)
Categorical age	0–4 years	14.20 (46)
	5–10 years	45.68 (148)
	11–15 years	29.63 (96)
	16–17 years	10.49 (34)
Sex	Female	49.07 (159)
Objective risk/sun sensitivity	(Min = 4; Max = 16)	10.05 (2.72)
Melanoma-related knowledge, beliefs, and barriers of parent respondents		
Knowledge score (range, 0–9)	7.05 (1.34)	—
Perceived risk of melanoma (compared with other children)		
More likely	—	53.27 (171)
Less likely/same	—	46.73 (150)
Discussed child's risk for melanoma with MD	—	46.27 (149)
Perceived efficacy of sun protection (range, 0–10)	8.65 (1.23)	—
Perceived severity of melanoma (range, 0–10)	9.54 (1.18)	—
Barriers to sun protection (range, 0–6)	3.50 (1.40)	—
Social norms score (range, 0–6)	2.58 (1.48)	—

NOTE: For melanoma-related knowledge, beliefs, and barriers variables higher mean scores reflect greater endorsement or level of the variable. See "Survey Instrument" for response options, coding, and scoring information for each variable.

Table 2. Child's use of sun protection practices, typical UV exposure, and sunburn history

Variable	Mean (SD)	% (*N*)
Sun protection (% responding "often/always")		
Wears sunscreen when outside on a sunny day	—	78.50 (252)
Wears a shirt with sleeves when outside on a sunny day	—	75.08 (241)
Wears a hat when outside on a sunny day	—	29.91 (96)
Stays in shade when outside on a sunny day	—	23.05 (74)
Wears sunglasses when outside on a sunny day	—	8.41 (27)
Sun protection composite (range, 1–4)	2.29 (0.50)	—
UV exposure during peak hours on summer weekend days		
Mean (range, <1–6)	2.91	
≤1 hour		18%
>1 to ≤3 hours		49%
4–6 hours		33%
Sunburn history		
Sunburn in past year (% yes)	—	43.03 (139)
Blistering sunburn (% yes, lifetime)	—	9.6

poorer perceived health compared with non-Latino whites ($P < 0.05$). In addition, mean time since diagnosis was 45 months among Latinos compared with 40 months in non-Latino whites, likely a consequence of recruiting Latino survivors diagnosed over a wider time period (2005–2009) compared with non-Latino whites (2007–2009).

Melanoma-related knowledge, beliefs, and barriers of parent respondents

Table 1 also presents information about factors at the level of the parent that were conceptualized to be potential correlates of sun protection practices and sunburn history among children in the sample. Parents were relatively well-informed about melanoma scoring a mean of 7.05 out of 9 on the knowledge summary score. Only half of parents believed their child to be at higher risk than other children, whereas remaining parents perceived their child at the same or lower risk than their other children for developing melanoma in their lifetime. Only 46% had discussed their child's risk for melanoma with a physician. On average, respondents endorsed 3.50 barriers of 6 assessed. Parents perceived sun protection methods as effective (a mean of 8.65/10) and also perceived melanoma as a severe disease (9.54/10).

Use of sun protection practices, typical UV exposure, and sunburn history

Data about sun protection practices, UV exposure, and sunburns history appear in Table 2. About three quarters of children "often or always" use sunscreen (79%) and wear a shirt with sleeves (75%) when outside on a sunny day. Substantially fewer children "often or always" wear a hat (30%), stay in the shade (23%), or wear sunglasses (8%). The mean sun protection composite value for children in the sample was 2.29 out of 4. The mean sun protection composite value for parents was 3.02 (data not in table). On a typical summer weekend day, children spent an average of 3 hours outside during peak hours (10 am–4 pm). Forty-three percent of children had experienced a sunburn over the past year and about 10% had experienced a blistering sunburn in their lifetime.

Bivariate and multivariate correlates of sun protection in children

Bivariate and multivariate analyses were conducted to assess the influence of demographic, family history, and psychosocial factors on overall sun protection (see Table 3). Results of bivariate analyses found the following factors to be associated with higher overall levels of child sun protection: younger age, female, higher objective risk, fewer barriers, greater perceived efficacy of sun protection, and higher perceived social norms supportive of sun protection. Ethnicity, time since diagnosis, stage at diagnosis, number of melanoma cases in family, melanoma-related knowledge, perceived risk, and perceived severity were not associated with overall sun protection. Although ethnicity was not significantly associated with sun protection in bivariate analyses, we decided to control for this factor in multivariate models given the observed relationships between race/ethnicity and other demographic factors (age, income, education, perceived health, and time since diagnosis) that, in turn, may have a combined influence on sun protection.

Multivariate analyses found that all factors significant in bivariate analyses remained independent predictors of sun protection with the exception of perceived efficacy of sun protection. We also conducted bivariate and multivariate analyses to predict use of individual sun protection strategies ("often/always" vs. "never/rarely/sometimes"), the results are shown in Table 3. Similar to analyses for our sun protection composite, correlates associated bivariately ($P \leq 0.10$) with individual sun protection strategies

Table 3. Multivariate analyses to assess factors associated with sun protection practices in children

Variable	Sun protection composite Coefficient (CI)	Sunscreen OR (CI)	Shirt use OR (CI)	Hat use OR (CI)	Seek shade OR (CI)	Sunglasses OR (CI)
Non-Latino white (vs. Latino)	0.055 (−0.08–0.19)	1.99 (0.97–4.10)	1.47 (0.73–2.95)	1.49 (0.65–3.45)	0.95 (0.43–2.11)	0.45 (0.17–1.22)
Child's age (cont.)	**−0.016 (−0.03–−0.01)**[a]	**0.87 (0.81–0.93)**[a]	**0.93 (0.87–0.99)**[a]	0.96 (0.90–1.02)	**0.94 (0.88–1.00)**[a]	**1.18 (1.06–1.31)**[a]
Boy (vs. girl)	**−0.099 (−0.19–−0.01)**[a]	n/a	**2.55 (1.46–4.43)**[a]	**3.11 (1.76–5.48)**[a]	n/a	**0.38 (0.16–0.93)**[a]
Objective risk (cont.)	**0.038 (0.02–0.06)**[a]	**1.14 (1.02–1.28)**[a]	n/a	**1.16 (1.04–1.29)**[a]	1.09 (0.98–1.21)	n/a
Barriers (cont.)	**−0.117 (−0.15–−0.08)**[a]	**0.78 (0.62–0.98)**[a]	**0.75 (0.60–0.93)**[a]	**0.72 (0.58–0.88)**[a]	**0.64 (0.52–0.80)**[a]	**0.64 (0.46–0.88)**[a]
Perceived efficacy	0.031 (−0.01–0.07)	n/a	n/a	**1.42 (1.09–1.87)**[a]	n/a	n/a
Social norms	**0.069 (0.04–0.10)**[a]	1.20 (0.98–1.48)	1.20 (0.99–1.45)	**1.26 (1.04–1.53)**[a]	**1.29 (1.06–1.57)**[a]	1.32 (0.99–1.77)
Perceived risk (more vs. less or same as other children)	n/a	n/a	1.68 (0.97–2.92)	n/a	n/a	n/a
Knowledge (cont.)	n/a	n/a	n/a	1.21 (0.96–1.53)	n/a	0.95 (0.69–1.32)
	$R^2 = 0.30$	—	—	—	—	—

NOTE: Bold text denotes significant variables in the models.
Abbreviations: Cont., continuous; n/a, variable excluded from multivariate model because not associated with sun protection in bivariate analyses.
[a]$P < 0.05$.

(each with a corresponding coefficient in Table 3) were included in the multivariate model for that strategy. In the interest of brevity, we will describe the results of multivariate models only. Barriers to sun protection were the most consistent independent predictor of individual sun protection strategies, emerging as significant in all five models predicting individual strategies. Child's age was another consistent predictor that was inversely related to use of sunscreen, shirt with sleeves, and shade seeking and positively related to wearing sunglasses. The relationship of child's gender to strategy use was dependent on the particular strategy in question. Boys were significantly more likely than girls to wear shirts with sleeves and hats, whereas girls were more likely than boys to wear sunglasses. Although race/ethnicity emerged as a significant bivariate predictor for sunscreen, hat and sunglass use, with whites more likely to use these strategies compared with Latinos, race/ethnicity did not emerge as a significant predictor for any of the individual sun protection strategies in adjusted analyses. Other factors were less consistently associated with sun protection, emerging as significant for only one or two strategies.

Correlates of sunburn in the past year in children

Factors associated with a higher likelihood of sunburn in the past year in bivariate analyses included: older age, higher objective risk, greater barriers to sun protection, higher perceived risk, and lower overall use of sun protection (See Table 4). Of these factors, only child's age, objective risk, and overall sun protection were retained as significant predictors in multivariate analyses.

Discussion

The primary purpose of this study was to examine sun exposure history and use of sun protection practices among children of melanoma survivors. In addition, the study sought to identify modifiable correlates of sun exposure and skin cancer prevention behaviors among these children guided by our conceptual framework. Adherence to recommended sun protection strategies, particularly sunscreen, was slightly higher than observed in a recent study conducted with a sample of children that had a range of risk for skin cancer (26) but comparable with recent estimates from a study of children of melanoma survivors (24, 27). The current study also provided an opportunity to examine use of individual strategies. Consistent with prior research conducted with average risk children and adults, we found sunscreen to be the most commonly used sun protection strategy (16, 51). Although sunscreen is an important tool in sun protection, overreliance on this method may be problematic. Prior studies have found sunscreen use to be positively correlated with UV exposure in adults, potentially due to a false sense of security (16, 51). Previous research has also found that sunscreen is often applied too infrequently or not reapplied properly after swimming or vigorous activity (52). Most children in our sample wore shirts with sleeves, which has been found to be important in reducing UV exposure on the shoulders, a common sunburn site (53). Fewer children wore hats, sunglasses or sought shade during peak hours, which may be potentially more helpful in reducing sun damage.

Table 4. Multivariate logistic regression analyses to assess factors associated with sunburn in past year

Variable	Sunburn OR (CI)
Non-Latino white (vs. Latino)	0.58 (0.29–1.14)
Time since diagnosis (continuous)	0.98 (0.96–1.01)
Child age (continuous)	**1.13 (1.07–1.20)**[a]
Objective risk (continuous)	**1.16 (1.05–1.29)**[a]
Barriers	1.08 (0.89–1.32)
Perceived risk (more vs. other)	1.30 (0.78–2.16)
Sun protection composite (continuous)	**0.49 (0.28–0.86)**[a]

[a]$P < 0.05$.

Certain factors emerged as robust correlates of sun protection. Consistent with prior literature, the risk for sunburn increases with age as children become less under the control of the parent and involved in more high-risk activities (54, 55). Although the model predicting overall sun protection revealed higher use among girls compared with boys, this relationship appears to be driven entirely by more frequent use of sunglasses among girls. Boys were two to three times more likely than girls to wear hats or shirts with sleeves, reflecting social norms regarding dress. Barriers to sun protection including child complaints about sun protection and concerns about the cost of sunscreen appear to be a strong influence on sun protection across strategies, consistent with the Health Behavioral Framework and relevant health behavior theory (34) and prior research (56–58) and represents a key target for interventions to improve sun protection and reduce sunburns in this group.

Other theoretical factors including social norms and perceived efficacy were less consistently related to sun protection use. This may reflect their lower relative importance in influencing sun protection or that they share variance with other factors. Moreover, our findings suggest that although sun protection appears to be influenced by several parent-level factors that are mutable to intervention, several immutable factors including child's age and child's objective risk for developing melanoma may also play a major role. Although not mutable via intervention, our results identify subgroups of children who may be in particular need of interventions (e.g., adolescents). Perceived risk of one's child to develop melanoma was lower than expected with only around one-half of parents perceiving their child to be at higher risk than his or her peers for developing the cancer in his or her lifetime. However, perceived risk was not associated with children's level of sun protection. Prior research has documented inconsistent relationships between perceived risk and health behavior in cross-sectional research, due to the potential reciprocal relationship between risk and health behavior performance (59, 60). As applied to the current study, parents who report high utilization of sun protection strategies for their child may, as a consequence, lower their perceptions of risk for their child. Thus, it is not that perceived risk has no influence on sun protection, but instead that cross-sectional studies fail to accurately capture the complex relationship between these factors.

The lack of relationship between some Health Behavior Framework Factors and sun protection levels may also support the importance of situational or contextual factors, which were not well-measured in this study. Although we focused on typical or "routine" use of sun protection strategies, future research may want to refine sun protection measures to more precisely measure sun protection in reference to a specific context (e.g., before each school day, during sporting events, during sunny vacations, etc). More precise measurement of sun protection may help to identify subgroups of high-risk children in greater need for intervention

and may help better explain sunburn frequency. Although ethnicity was not an independent predictor of sun protection, Latino children were less likely to wear sunscreen and hats and more likely to wear sunglasses in unadjusted analyses. Although we believe the inclusion of Latinos in the study is valuable, we acknowledge that the study is underpowered to draw conclusions for this group. Future research should consider recruiting Latino and non-Latino white survivors diagnosed over a wider time frame than in the current study, which may allow recruitment of a larger number of Latino survivors and more comparable Latino and non-Latino white study samples with regard to time since diagnosis.

Despite the high reported use of sun protection, sunburns were common. Although data regarding sunburns in young children are limited, the sunburn frequency we observed is within the range of estimates derived from population-based studies with U.S. adolescents (61, 62) and adults (25). The sunburn frequency experienced by children in our sample may reflect their vulnerability to sunburns given the sun sensitive phenotypic characteristics they share with their parent who is a melanoma survivor. Nevertheless, our findings suggest that sun protection levels remains insufficient for this group. In addition to their increased risk due to family history, children were outdoors in the sun during peak hours, raising their risk for sunburns. Reducing sun exposure may be particularly challenging for children in California. In Southern California where more than one-third of the population of the state resides, the weather is conducive to outdoor activities year round. Older children and those more sensitive to the negative effects of the sun were more likely to have experienced a recent burn, which although does not represent a target for change identifies subgroups of children particularly vulnerable to sunburns. The only mutable factor associated with sunburn was typical sun protection level, underlining the importance of regular adherence to recommended sun protection practices.

Given the limited resources available for this pilot study, strengths of the study include a larger sample size than prior studies focused on children of melanoma survivors (24, 56) and use of a population-based cancer registry for recruitment, which allowed recruitment of a higher proportion of Latino survivors than would be possible with a random sampling approach or within clinical settings. Investigation of individual sun protection strategy use as well as overall sun protection level assessed via our composite measure represents another study strength. We believe that composite sun protection measures are particularly valuable in analyses conducted to identify correlates of sun protection. Some parents may utilize one strategy more often than another for their child or rely on one or two strategies that diminish the importance of others (i.e., protective clothing may reduce importance of sunscreen). Thus, it is important to include composite sun protection measures in addition to examination of individual strategies, and to interpret findings across all outcomes in combination.

Several limitations should be noted, including use of a cross-sectional design and the limited response rate. The yield we observed, however, is fairly consistent with other studies utilizing cancer registries for recruitment (63). The fact that cancer registries often have inaccurate or out-of-date contact information for a sizable proportion of registrants is a likely contributing factor to the low yields observed in studies using this type of recruitment approach.

Although random sampling was used to initially select non-Latino melanoma survivors to be contacted for the study, parents who reported having more than one child were asked to report on the child closest to or within the 5- to 10-year-old age range. Therefore, it should be noted that children were not randomly selected from within families with more than one child. Use of self-report for sun exposure and sunburn outcomes without objective verification of these outcomes is also a limitation, although challenging to overcome given researchers had no in-person contact with participants. In addition, the lack of observed relationship between melanoma knowledge and study outcomes may underscore some of the weaknesses of the knowledge measure we utilized. Future research may want to consider more refined measures of sun protection knowledge to assess knowledge of sun protection recommendations, suggested frequency of sunscreen reapplication, need for daily versus event-based sun protection, and other relevant nuances. This level of increased precision for knowledge measures, and potentially other mutable factors, coupled with more detailed and context-specific measures of sun protection may enhance our understanding of these relationships and point more specifically to targets for intervention.

Study results support the development of interventions for children at increased risk for melanoma due to parental history to improve sun protection and reduce sunburn frequency. Our findings highlight the importance of ensuring melanoma survivors are aware of their child's risk status and consider discussing this issue with a health care provider, which occurred infrequently in our sample. Reducing common barriers to sun protection such as dealing with a child's complaints about sun protection would also be important targets for intervention. We were only able to locate one published study that reported the effect of an intervention focused on children with a parental history of melanoma (27). The results of this study revealed a significant effect of the intervention, which included a combination of print mailings and short DVD, on reapplication of sunscreen at 1 month follow-up and hat use at 4-month follow-up but not on sunburn frequency or other sun protection outcomes. Future innovative parent-focused interventions may consider the inclusion of mobile health components such as text message reminders or social media to intensify the effect of existing interventions, which may potentially lead to larger and more consistent effects on the range of outcomes being targeted.

In addition to innovative parent-focused interventions, future efforts to reduce sunburns in high-risk populations should encourage high risk populations to seek shade and increase use of hats and sunglasses in addition to reducing outdoor activities during peak hours. The high level of UV exposure we observed also supports the need for policy-level efforts to reduce skin cancer risk among children including increasing access to shade in schools and public parks and establishment of policies to remove barriers to use of sunscreen and hats during the school day (64). These upstream efforts will support high-risk families and will also be important for the entire population who remains at risk for melanoma and nonmelanoma skin cancers.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Authors' Contributions

Conception and design: B.A. Glenn, W.K. Wong, K. Glanz, R. Bastani
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Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): B.A. Glenn, R. Bastani
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): B.A. Glenn, L.C. Chang, W.K. Wong, R. Bastani
Writing, review, and/or revision of the manuscript: B.A. Glenn, T. Lin, L.C. Chang, K. Glanz, R. Bastani
Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): B.A. Glenn, T. Lin, A. Okada
Study supervision: B.A. Glenn, R. Bastani

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