# Parent reports of sun safety communication and behaviour for students in a randomised trial on a school policy implementation intervention

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## Abstract

**Objective**: Schools are an important setting for skin cancer prevention. An intervention for implementation of school sun safety policy, Sun Safety Schools (SSS), was evaluated.

**Methods**: Primary schools (n=118) in California school districts that had already adopted a sun safety policy were enrolled in a study with a randomised controlled design. Half of the schools were randomised to SSS intervention (N=58). Parents completed an online post-test.

**Results**: More parents in intervention schools received information about sun safety (mean=26.3%, sd=3.1%, p=0.017) and children more frequently wore sun-protective clothing when not at school (mean=2.93, sd=0.03, p=0.033) than in control schools (mean=18.0%, sd=2.5%; mean=2.83, sd=0.03, respectively). In schools where principals reported implementing sun safety practices, parents reported that children spent less time outdoors at midday (mean=14.78 hours, sd=0.25, p=0.033) and fewer were sunburned (mean=12.7%, sd=1.1%, p=0.009) than in non-implementing schools (M=16.3 hours, sd=0.67; mean=21.2%, sd=3.8%, respectively). Parents who received sun safety information (mean=3.08, sd=0.04, p=0.008) reported more child sun protection than parents not receiving information (mean=2.96, sd=0.02).

**Conclusions**: A school district sun protection policy and support for implementation increased dissemination of sun safety information to parents and student sun safety.

**Implications for public health**: Technical assistance for sun safety policies may increase sun protection of children.


**Key words**: cancer, skin, prevention, school, policy

In 2017, the worldwide incidence of melanoma was 309,000, making it among the most common cancers diagnosed.[1] Melanoma is most common in Australia and New Zealand (an estimated 54 age-standardised cases per 100,000 in 2015[2]) and also occurs in the United States (22 age-standardised cases per 100,000 nationwide and 22 age-standardised cases per 100,000 in California[3] in 2016). Further, more than five million Americans will be diagnosed with keratinocyte skin cancers annually.[4]

In response to the high prevalence of skin cancer in the United States, the Centers for Disease Control and Prevention (CDC)[5] and the Surgeon General[6] have called on America's schools to help prevent skin cancer. Children receive substantial solar ultraviolet radiation (UV) exposure, including while at school,[7] and are frequently sunburned.[8] Skin cancer prevention in schools can help to prevent skin cancer by: 1) taking actions that reduce students' UV exposure on school grounds; and 2) implementing sun protection interventions in schools that encourage sun safety habits in children that potentially reduce lifetime sun exposure. The CDC and the Surgeon General recommend that US schools include sun safety in policy and education; however, skin cancer prevention policies and practices are not commonly implemented.[9]

A randomised trial was conducted to test an intervention that supported the implementation of school district sun safety policy in a sample of primary schools in California school districts that had already adopted a sun safety policy. The policy conformed with CDC guidelines,[5] reflected the holistic approach in the World Health Organization's Health Promoting Schools framework[10,11] (i.e. classroom curricula, shade in school environments, administrative procedures [scheduling, resource allocation, monitoring, and teacher and staff training], communication with parents, and personal protection by students [sunscreen, hats, and sun-protective clothing and eyewear]) and was recommended by the California School Boards Association (CSBA). This paper reports tests of the hypothesis that parents would report: a) more communication from schools about sun safety; and b) increased sun safety behaviour of students at schools receiving the Sun Safe Schools (SSS) intervention than at control schools receiving minimal

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information on sun safety. While some studies have explored factors that relate to the implementation of school sun safety practices (e.g. geographic region,[12] population density,[13] grade level,[12,13] enrolment size,[12,14] student socioeconomic status[12] and resources[15]), very few studies have tested interventions intended to facilitate policy implementation.[16,17] Implementation of school sun safety practices in the trial are reported elsewhere.[18]

## Methods

### Sample

Parents with a child enrolled in participating primary schools were recruited to complete a post-test survey by: 1) invitations sent by principals to all parents in participating schools by email or handouts sent home with students; or 2) project staff attending parent-oriented events (e.g. back-to-school night). Primary schools were selected from a list of school districts that had already adopted the CSBA model sun safety policy, designated Board Policy (BP) 5141.7. Eligible schools had students in grades K-6 (aged 5–11) and were located in districts that posted their sun safety policy, BP 5141.7, online (staff coded policies and verified eligibility[19]). Between September 2013 and December 2015, school principals were invited to have the schools participate (see CONSORT diagram in Figure 1). The average UV index is high enough in most months in California that sun protection is advised.[20] Principals at 118 out of 489 (24%) primary schools (in 59 districts) located in 17 counties consented to participate (mean enrolment=564 students; sd=216). On average, 27.8% of students were English-learners (sd=17.0%), 64.1% participated in a free/reduced-price meal program (sd=28.8%), and 54.5% were Hispanic (sd=26.4%), with 24.0% non-Hispanic White (sd=22.3%).

### Design of the randomised trial

Schools were enrolled in a study using a pre-test-post-test randomised controlled experimental design. Principals were contacted by email and telephone to recruit them into the study. Following pre-testing, schools were randomised to the intervention (N=58 schools) or control group (N=60 schools) by the project biostatistician, in monthly batches, given the rolling recruitment procedure. The SSS intervention was delivered over 20 months. Control schools were sent three emails containing basic sun safety information (e.g. CDC's *Guidelines for School Programs to Prevent Skin Cancer*). At 20-months post-randomisation, parents were asked to complete a post-test online or paper format questionnaire (n=0 to 85 per school; *a priori* power calculations set the sample size at 15 parents per school; response rates could not be calculated because the number invited was unknown). Schools were compensated US$10 per parent response, to a maximum of US$200. The trial was classified as exempt by the Claremont Graduate University Institutional Review Boards based on the minimal risk to participants, lack of deception and anonymity of the parent surveys.

### Sun Safe Schools intervention

The SSS intervention (see full description elsewhere[18]) was based on Diffusion of Innovation Theory (DIT)[21] and involved trained sun safety coaches providing support to school staff for policy implementation. Coaches met with school principals, the content of the district's sun safety policy (from policy coding) was reviewed, a sun safety practice checklist was completed, information resources provided and plans formulated for implementing sun safety practices. Coaches assessed the school principals' readiness for implementing practices based on DIT and tailored their assistance based on readiness. Following the first meeting, coaches sent a monthly email, tailored to the principals' readiness, needs and interest. Coaches encouraged implementation, checked on implementation, helped principals cope with implementation barriers and provided additional resources. Of the 58 intervention principals, 91% (n=53) met with coaches and 100% of the principals who met with coaches selected sun safety actions on the implementation checklist (range=1-16 actions selected). Of the 53 principals, 34 selected they "might do" parent outreach and five reported they were "doing now" (14 answered "won't do" or did not respond for that practice).

### Parent measures

At post-test, parents reported on whether they received any information from the school on sun safety or other health and safety topics (i.e. nutrition, physical activity, vaccinations, injury prevention and stress). For those recalling messages on sun safety, parents reported the type of communications (i.e. conversation from child's teacher, other school personnel or parent of another student, written, audio, or video materials, information in regular communications, letter from school's parent organisation, information presented during special events, or other information), how much they read, listened to, or watched (i.e. none=0, all of it=4), and how informative it was (not at all=1, very=4).

Parents reported on the sun protection and sun exposure of their child. If more than one child was in the participating primary school, one child was randomly selected as the target child for measures. Parents reported on the frequency of sun protection practised by their child when outdoors in the sun in the last three months on a warm, sunny day, when not at school: sunscreen with SPF 15 or greater (in Australia and New Zealand, SPF 30+ is recommended[22]), clothing that protected the skin from the sun such as long sleeve shirts and long pants, hat with a brim, shade or under an umbrella, or sunglasses (never=1, 5=always). Parents reported how many hours the child was outside per day between 10 am and 4 pm on weekdays and on weekend days (none, 30 min. or less, 31 min. to 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more) and if the child had been sunburned (i.e. red and/or painful skin from exposure to the sun) in the past three months.

Parents answered questions to assess control variables. These included demographic questions for self and child, skin type measure for self and child (based on hair colour, eye colour and skin tannability)[23] and family history of skin cancer. Parents also reported on their own sun protection behaviours, duration of sun exposure on weekdays and weekend days, and sunburn prevalence. Finally, they evaluated the perceived susceptibility to skin cancer, desire to suntan, perceived importance of and self-efficacy for skin cancer prevention for their children and barriers to skin cancer prevention for their children (e.g. sunscreen: conflict, stop outdoor activities, messy, hard to choose correct one, not in easy location to use; sun-protective clothing: complaints, too hot to wear; shade: will miss out on outdoor activities) on 5-point Likert scales.

### Principal implementation reports

At post-test, principals reported whether anyone in the school had implemented sun safety practices in ten practice categories since the baseline assessment (Yes, No, Don't

Know). If they answered affirmatively, they indicated if anyone had done specific actions within that category (Yes, No, Don't Know). A dichotomous implementation measure was used in the analysis, with a Yes value if at least one sun safety practice was implemented in any category.

### School characteristics

Information on the school enrolment was obtained from the California Department of Education records. This included number of students and administrators and proportion of minority students (i.e. Hispanic, African American, Asian, Filipino, Pacific Islander and Native American/Alaska Native), English learners (students who do not speak, read, write or understand English well as a result of English not being their home language), and students in free or reduced-price meal programs (proxy for income). Distance from the project office in Claremont, California, was calculated in miles.

### Statistical analysis

Initially, effects of treatment group on parents' reports on: a) communication about sun safety from the schools; and b) sun safety behaviours of student (i.e. time spent outdoors in the sun, sunburn prevalence, and sun protection behaviour) were modelled, with parents nested within schools. Frequency items for the five sun protection behaviours were analysed separately and as a composite measure created by averaging the frequency ratings across the five items. School and respondent characteristics were included as covariates. PROC GLIMMIX in SAS 9.3 was used for logistic regression on binary outcomes or Poisson regression on count outcomes. PROC MIXED was used for linear regression on percentage outcomes. The effects of parents recalling communication about sun safety from the schools and school principals reporting implementation of sun safety practices at the school on student sun safety were tested: 1) as predictors of students' time outdoors, sunburn prevalence, and composite sun protection behaviour; and 2) as mediators. The former used models similar to those employed to test the treatment effect. The latter used mediation models in Mplus using 2-1-1 multilevel mediation to investigate if parents recalling communication mediates the effects from treatment group to students' sun exposure and sun protection behaviours. All tests were evaluated at a two-tailed $p$=0.05.

## Results

### Profile of the Sample

A total of 1,758 parents completed the post-test (367 consented but did not complete [17.3% of consented parents]; see Figure 1). Parents (n=933 in intervention schools and n=825 in control schools) were predominantly female and middle-aged; more than half had a four-year college or postgraduate degree; three-quarters were White; and a third were Hispanic (Table 1). Almost 19% had a skin type at high risk for developing melanoma (i.e. red or blond hair, hazel, blue, green or grey eyes, and skin that only mildly or never sun tans) and one-quarter reported a family history of skin cancer. Children were distributed across all of the primary school ages, with half being female, 72% White, 40% Hispanic and 19% having highest-risk skin types. Also, two in five parents had more than one child enrolled in a primary school. More parents in the SSS intervention group were older, had higher education, and were White than parents in the control group (see Table 1). No parents were surveyed at 19 schools: one school had closed by post-test, 13 principals did not respond to the request to survey parents, two principals refused to survey parents, and at three schools, no parents responded [at one school, only one parent responded]). At 98 schools, surveys were completed by two or more parents (mean=17.9 completed surveys per school; range=2–85).

### Effect of sun-safe schools intervention on communication to parents

As hypothesised, more parents from schools in the intervention group reported receiving information about sun safety from their

**Figure 1: Consort diagram for trial.**

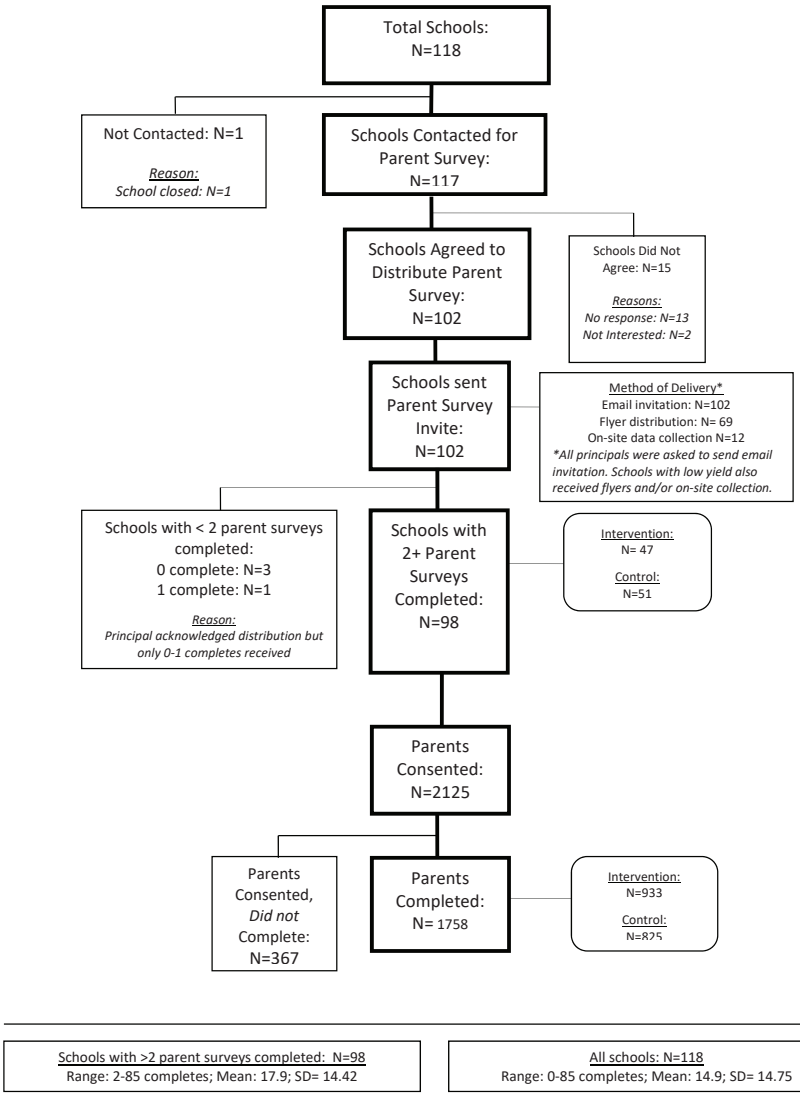

**Table 1: Profile of the parents.**

| Characteristic | Parents | | | |
|---|---|---|---|---|
| | All (n=1,758) Mean ± SD or No. (%) | Control (n=825) Mean ± SD or No. (%) | Intervention (n=933) Mean ± SD or No. (%) | p |
| **Have another child enrolled in a California primary school** | | | | |
| Yes | 689 (40.5%) | 333 (41.6%) | 545 (60.5%) | 0.376 |
| No | 1,012 (59.5%) | 467 (58.4%) | 356 (39.5%) | |
| **Skin type** | | | | |
| 1 (darkest) | 403 (24.0%) | 184 (23.2%) | 219 (24.8%) | 0.125 |
| 2 | 559 (33.4%) | 288 (36.3%) | 271 (30.7%) | |
| 3 | 368 (22.0%) | 172 (21.6%) | 196 (22.2%) | |
| 4 | 316 (18.8%) | 139 (17.5%) | 177 (20.1%) | |
| 5 (lightest) | 30 (1.8%) | 11 (1.4%) | 19 (2.2%) | |
| **Family history of skin cancer** | | | | |
| Yes | 417 (24.1%) | 188 (23.1%) | 229 (25.1%) | 0.342 |
| No | 1311 (75.9%) | 626 (76.9%) | 685 (74.9%) | |
| **Mean age, years** | 39.02 (7.59) | 38.58 (7.66) | 39.42 (7.51) | 0.025 |
| **Education** | | | | |
| High school graduate or less | 264 (15.5%) | 116 (14.3%) | 148 (16.5%) | 0.045 |
| Some education beyond high school | 549 (32.2%) | 278 (34.3%) | 271 (30.3%) | |
| Bachelor's degree | 486 (28.5%) | 242 (29.9%) | 244 (27.3%) | |
| Postgraduate degree | 406 (23.8%) | 174 (21.5%) | 232 (25.9%) | |
| **Hispanicity** | | | | |
| Hispanic | 603 (37.3%) | 287 (36.9%) | 316 (37.5%) | 0.805 |
| Not Hispanic | 1016 (62.7%) | 490 (63.1%) | 526 (62.5%) | |
| **Race** | | | | |
| American Indian/Alaska Native | 38 (2.8%) | 26 (4.0%) | 17 (1.7%) | 0.018 |
| Asian | 150 (11.0%) | 84 (12.8%) | 66 (9.3%) | |
| Black/African American | 71 (5.2%) | 35 (5.3%) | 36 (5.1%) | |
| Native Hawaiian/Other Pacific Islander | 22 (1.6%) | 12 (1.8%) | 10 (1.4%) | |
| White | 1035 (75.9%) | 474 (72.1%) | 561 (79.5%) | |
| More than one race | 47 (3.5%) | 26 (4.0%) | 21 (3.0%) | |
| **Gender** | | | | |
| Female | 1516 (89.0%) | 713 (87.9%) | 803 (89.9%) | 0.187 |
| Male | 188 (11.0%) | 98 (12.1%) | 98 (10.1%) | |
| **Child's skin type** | | | | |
| 1 (darkest) | 396 (23.7%) | 193 (24.3%) | 203 (23.2%) | 0.047 |
| 2 | 534 (32.0%) | 272 (34.3%) | 262 (29.9%) | |
| 3 | 423 (25.4%) | 188 (23.7%) | 235 (26.8%) | |
| 4 | 289 (17.3%) | 133 (16.8%) | 156 (17.8%) | |
| 5 (lightest) | 27 (1.6%) | 7 (0.9%) | 20 (2.3%) | |
| **Child's age (years)** | | | | |
| 4 | 15 (0.9%) | 9 (1.2%) | 6 (0.7%) | 0.745 |
| 5 | 152 (9.2%) | 73 (9.4%) | 79 (9.1%) | |
| 6 | 239 (14.5%) | 106 (13.6%) | 133 (15.3%) | |
| 7 | 268 (16.3%) | 136 (17.5%) | 132 (15.2%) | |
| 8 | 259 (15.7%) | 117 (15.1%) | 142 (16.3%) | |
| 9 | 252 (15.3%) | 128 (16.5%) | 124 (14.2%) | |
| 10 | 224 (13.6%) | 99 (12.7%) | 125 (14.3%) | |
| 11 | 162 (9.8%) | 74 (9.5%) | 88 (10.1%) | |
| 12 | 53 (3.2%) | 24 (3.1%) | 29 (3.3%) | |
| 13 | 24 (1.5%) | 11 (1.4%) | 13 (1.5%) | |
| **Child's mean age, years** | 8.16 (2.04) | 8.12 (2.03) | 8.18 (2.05) | 0.550 |
| **Child's Hispanicity** | | | | |
| Hispanic | 644 (40.4%) | 307 (40.3%) | 337 (40.4%) | 0.994 |
| Not Hispanic | 952 (59.6%) | 454 (59.7%) | 498 (59.6%) | |
| **Child's Race** | | | | |
| American Indian/Alaska Native | 39 (2.8%) | 22 (3.3%) | 17 (2.4%) | 0.321 |
| Asian | 136 (9.9%) | 77 (11.6%) | 59 (8.3%) | |
| Black/African American | 72 (5.3%) | 35 (5.3%) | 37 (5.2%) | |
| Native Hawaiian/Other Pacific Islander | 17 (1.2%) | 8 (1.2%) | 9 (1.2%) | |
| White | 990 (72.1%) | 463 (70.1%) | 527 (73.9%) | |
| More than one race | 120 (8.7%) | 56 (8.5%) | 64 (9.0%) | |
| **Child's gender** | | | | |
| Female | 809 (49.1%) | 368 (47.4%) | 441 (50.6%) | 0.194 |
| Male | 838 (50.9%) | 408 (52.6%) | 430 (49.4%) | |

child's school than parents from schools in the control group (Table 2). The treatment group was not associated with receiving information on other health or safety topics.

### *Effect of sun-safe schools intervention on child sun protection reports*

The prediction that parents would report better sun protection of children in the intervention than control groups was supported for parents reports on their children wearing sun-protective clothing when not in school (Table 2).

### *Effect of policy implementation at schools on child sun protection reports*

There was further evidence of the impact of implementing the school districts' sun safety policy (Table 3). In schools where the principals reported implementing at least one sun safety practice, parents reported that students spent less time outdoors and reported that fewer students were sunburned than at schools where principals did not implement. Parents who reported that they received information about sun safety from the school reported greater composite student sun protection behaviour than parents not receiving this information.

We also tested whether parents' receipt of sun safety communication from the schools mediated the effect of the SSS intervention on their reports of the composite sun protection behaviour of the student. In mediational analyses, parents' receipt of sun safety communication appeared to mediate the effect of the SSS intervention (b=0.021, $p$=0.001) when not adjusting for the multi-level design (i.e. students within schools within school districts), with 34.6% of the intervention effect on student sun safety behaviour mediated by parents reporting sun safety communication from the school. However, this mediation was not evident when adjusting for school and school district levels (b=0.034, $p$=0.456).

## Discussion

Parents confirmed that the SSS intervention increased implementation of school sun safety practices, specifically communicating with them about sun safety of students (e.g. inserting sun safety in the parent handbook, distributing information on sun safety and children's risk factors, ways to

communicate about sun safety and how to be a sun-safe family, and requesting parents provide sunscreen and wide-brimmed hats for field trips). These data add to the little information that is available on how the implementation of school sun safety practices influences student sun protection. In Australia, one study suggested that the SunSmart school policy may improve students' use of wide-brimmed hats[24] and a second study found that a majority of students were wearing a sun-safe hat but use of sunscreen was low at primary schools participating in the SunSmart program.[25] A limitation in the published literature is that many past studies have focused on a single type of school practice such as school curricula,[26,27] communication to parents,[28] or shade on school grounds,[29] with only a few studies attempting to prospectively influence environmental controls, administrative procedures and personal protection behaviours simultaneously, and to associate that with student sun safety. A recent intervention in the Greater Western Sydney region aimed to improve hat and sunscreen use, and teacher role modelling of sun safety in primary schools participating in the SunSmart schools' program. It produced a large increase in observations of sunscreen use, only small increases in hat use and no improvements in teacher role modelling.[16,17] A multi-faceted school intervention in the US that used sunscreen, curricula, UV Index announcements, guest speakers, and school policy found that primary school students increased reported use of sunscreen and sunglasses.[30]

According to the WHO, engaging families in promoting health behaviour such as sun protection is an essential feature of health-promoting schools. However, a Cochrane review concluded that this component has been only weakly implemented in past research.[10] It is notable that the SSS intervention motivated many principals to select parent communication as a practice to implement when working with the SSS coaches, and more principals at intervention schools also reported communicating with parents about sun safety and requested parents provide sun safety resources (e.g. sunscreen and sun-protective clothing) than principals at control schools.[18] Further, parents did not report any differences in the schools' communication about other health and safety topics by treatment group, suggesting that the intervention

**Table 2: Comparison of parents' reports of sun safety communication from schools and child sun protection (in adjusted mean/percentages ± sd) by experimental condition.**

| | Control (n=825) | Intervention (n=933) | Test statistic (F) | p |
|---|---|---|---|---|
| **Sun Safety Communication from Schools (in past two years)** | | | | |
| Received any information about sun safety[11,13,14,16,19,24] | 18.0% (2.5%) | 26.3% (3.1%) | 5.72 | 0.017 |
| Received any information about health and safety topics[14,19,22,23] | 73.1% (2.4%) | 75.4% (2.2%) | 0.51 | 0.477 |
| Number of health and safety topics on which parent received information[6,11,14,16,19,22,23,24] | 2.12 (0.11) | 2.01 (0.10) | 0.66 | 0.421 |
| **Child Sun Exposure** | | | | |
| Total number of hours the child spent outside between 10 am and 4 pm during the week[4,6,15,22] | 14.78 (0.34) | 14.96 (0.33) | 0.14 | 0.709 |
| Sunburned in the past three months[3,5,12,17,20,21,22] | 12.5% (1.7%) | 11.6% (1.5%) | 0.16 | 0.686 |
| **Child Sun Protection Behaviours (Frequency Ratings)*** | | | | |
| Wearing sunscreen with SPF 15 or greater[1,2,4,5,6,21,22] | 3.50 (0.04) | 3.56 (0.04) | 0.88 | 0.349 |
| Wearing clothing that protected child's skin from the sun, such as long sleeve shirts and long pants[2,3,4,5,6] | 2.83 (0.03) | 2.93 (0.03) | 4.58 | 0.033 |
| Wearing a hat with a brim[4,5,6,10] | 2.76 (0.05) | 2.86 (0.05) | 1.85 | 0.174 |
| Staying in the shade or under an umbrella[2,3,4,6,9,10,16,18,23] | 3.02 (0.04) | 3.04 (0.04) | 0.10 | 0.747 |
| Wearing sunglasses[5,6,9,18,22,23] | 2.54 (0.05) | 2.68 (0.05) | 3.23 | 0.073 |
| Composite sun protection behaviours[1,2,3,4,5,6,9,19,23] | 2.95 (0.03) | 3.01 (0.03) | 2.60 | 0.107 |

*Notes:*

**5-point response scale, 1=Never, 5=Always; composite measure calculated by averaging the five individual frequency ratings.*

*Comparison was adjusted for [1]parent perceived importance skin cancer prevention; [2]parent perceived appearance with tan; [3]parent perceived personal risk for skin cancer; [4]complaint about wearing long-sleeve shirts or long pants in the summer; [5]negative opinions about sunscreens; [6]parent confidence in getting children to practice sun safe behaviours; [7]parent phenotypic index; [8]family skin cancer history; [9]parent age; [10]parent ethnicity and race; [11]parent gender; [12]primary school only vs. primary and middle/high school; [13]distance in miles from School of community and Global Health; [14]total number of students enrolled; [15]total number of teachers; [16]total number of administrators; [17]student teacher ratio; [18]per cent of students in free or reduced price meals program; [19]per cent of Hispanic or Latino students; [20]per cent of Hispanic or Latino teachers; [21]per cent of Hispanic or Latino administrators; [22]per cent of White non-Hispanic students; [23]per cent of White non-Hispanic administrators; [24]per cent of female students. Sample size is slightly reduced when covariates are added in the models.*

**Table 3: Comparison of parents' reports of child sun protection (in adjusted mean/percentages ± sd) by sun safety practices implementation and sun safety communication from schools.**

| | Did not implement sun safety practices (n=218) | Implemented sun safety practices (n=1,383) | Test statistic (F) | p | Did not recall sun safety communication (n=1,284) | Recalled sun safety communication (n=330) | Test statistic (F) | p |
|---|---|---|---|---|---|---|---|---|
| Total number of hours the child spent outside between 10 am and 4 pm during the week[4,6,9,14] | 16.32 (0.67) | 14.78 (0.25) | 4.56 | 0.033 | 14.70 (0.27) | 15.65 (0.50) | 3.02 | 0.082 |
| Sunburned in the past three months[3,5,8,10,12,13,14] | 21.2% (3.8%) | 12.7% (1.1%) | 6.81 | 0.009 | 12.4% (1.3%) | 12.8% (2.1%) | 0.03 | 0.865 |
| Composite sun protection behaviours*[1,2,3,4,5,6,7,11,15] | 3.02 (0.06) | 2.99 (0.02) | 0.33 | 0.567 | 2.96 (0.02) | 3.08 (0.04) | 7.14 | 0.008 |

*Notes:*

**Composite score calculated by averaging the five individual frequency ratings.*

*Comparison was adjusted for [1]parent perceived importance skin cancer prevention; [2]parent perceived appearance with tan; [3]parent perceived personal risk for skin cancer; [4]complaint about wearing long-sleeve shirts or long pants in the summer; [5]negative opinions about sunscreens; [6]parent confidence in getting children to practice sun safe behaviours; [7]parent age; [8]primary school only vs. primary and middle/high school; [9]total number of teachers; [10]student teacher ratio; [11]per cent of Hispanic or Latino students; [12]per cent of Hispanic or Latino teachers; [13]per cent of Hispanic or Latino administrators; [14]per cent of White non-Hispanic students; [15]per cent of White non-Hispanic administrators. Sample size is slightly reduced when covariates are added in the models.*

increased school communication about sun safety specifically, not health and safety communication generally. Communication with parents may be common in school sun safety efforts because principals can easily reach parents through established channels and sun safety may be seen as a shared responsibility with parents, especially because parents must supply personal sun protection items (e.g. sunscreen and protective clothing) and can help teach children age-appropriate sun protection information and skills.[11] It is also important that parents' attitudes and behaviours regarding sun safety are consistent with those promoted by the school policy and practices and for parents to be role models for the practice of sun safety.[11]

The influence of the SSS intervention on student sun protection was not as comprehensive as hoped. The SSS intervention appeared to increase only sun-protective clothing use; however, clothing can provide very effective sun protection. Clothing shields the skin from both UVA and UVB and is more long-lasting and effective than sunscreen because it will not rub or sweat off and does not require adequate use or reapplication. Parents can dress the child in the morning before school and clothing will continue to protect whenever they are outdoors. Although rare in US public schools, school uniforms could be selected with long sleeves and long pants to be sun protective. Further, it does not require school personnel to physically touch children, as they may need to do for sunscreen.

To achieve improvements in student sun safety, it was necessary for schools to implement sun safety practices, and especially to communicate with parents. When schools did this, practices appeared to reduce students' sun exposure, improve their sun protection behaviours and ultimately reduce sunburning. Repeated sunburns have been linked to the development of skin cancers,[31-33] so sun protection policy, when implemented, may have a real chance of reducing lifetime risk for skin cancer. When it comes to sun exposure of children, it is important to focus on exposure during midday periods of peak UV, rather than just advising less time outdoors, to ensure that sun protection does not reduce physical activity – a beneficial health behaviour for children.

Future research is needed to understand issues such as which policy elements improve student sun safety, whether some practices more effective than others (e.g. if durable changes in shade are more effective than teaching sun safety skills), whether a certain combination of elements improves effects on children (e.g. if parental communication is essential for effective curricula) and how long it takes for practices to create improvements in student sun safety. Without this information, conclusions about whether SSS was effective at protecting children are uncertain. It may be that SSS did a good job at increasing school sun safety practices but the practices were insufficient to affect students, suggesting that SSS needs improvement (e.g. it might include direct outreach to parents to support sun safety for students, along with information from schools). It could be that the 20-month intervention period was too short for the school practices to affect students and intervention efforts are needed to sustain practice implementation to achieve change in student skin cancer prevention. Finally, policy implementation might need to continue for many years and especially into secondary grades where personal appearance norms develop and peer pressure increases, either of which can increase suntanning[34,35] and elevate children's risks of skin cancer. Future research should examine not only how school practices can sustain their impact as children age but also how one can effectively intervene with secondary schools.

The trial has a number of strengths and weaknesses.[18] The prospective, randomised design, the high level of participation by schools (>90%) in the intervention, and the very high retention rates (>90%) ruled out several threats to validity. However, the location in California and the low school recruitment rate (24%) may reduce generalisability. Self-reports can be subject to social desirability and demand effects. Parent reports have agreed with student reports and shown construct validity, but they did not relate to skin tone measurement[36,37] (parental reports of children's dietary behaviour have shown variable validity[38]). Parents reported on time outside of school when they probably should spend more time with children, so that they can more readily observe their behaviour and more accurately report on that behaviour. The parent sample was self-selected. Fortunately, there were only a few differences in parent characteristics between treatment groups, but they did suggest that intervention group parents were at higher risk of skin cancer than control group parents.

The US CDC and Surgeon General have joined health authorities in Australia, New Zealand and worldwide to identify schools as a priority community venue for skin cancer prevention efforts.[5,6,11,39-42] Schools can improve sun protection for students by adopting health-promoting policies that increase communication of skin cancer information and sun safety advice to parents as well as curricula, environmental features and administrative procedures to establish lifelong sun safety habits among students, which could reduce sunburns as well as their overall sun exposure and lower their lifetime risk of skin cancer.

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