

Evaluation of the *Sunny Days, Healthy Ways* Sun Safety Curriculum for Children in Kindergarten through Fifth Grade

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Abstract: Childhood sun protection is important to reduce the risk of developing skin cancer later in life. An evaluation of an expanded version of the *Sunny Days, Healthy Ways* sun safety instructional program was conducted with 744 students in 77 kindergarten to fifth grade classes in 10 elementary schools. Students in six schools received instruction twice over two school years. Students in four schools received it only once in a single school year or were enrolled in a no-treatment control group. A single presentation of the sun safety materials improved sun safety knowledge in students in grades 2–5 ($p < 0.05$). Repeated presentation over 2 years improved all outcomes, including increasing self-reported sun protection ($p < 0.05$) and decreasing skin darkening indicative of exposure to ultraviolet radiation ($p < 0.05$). The program did not improve children's knowledge or skin darkening in kindergarten and grade 1. These results highlight the need to provide sun protection education over several school years, not just one time, to produce changes in sun safety behavior.

Skin cancer is the most common malignancy in the United States (1). Ultraviolet radiation (UVR) exposure is the most preventable risk factor for skin cancer (2), reduced by avoiding the sun during daily peak UVR periods, wearing protective clothing, and applying sunscreen.

Sun protection must start early in life (3,4). It has been estimated that a quarter of lifetime sun exposure, which is associated with developing squamous cell carcinoma and melanoma (5,6), occurs before age 18 (7). Severe sunburns may be linked to melanoma and to basal cell and squamous cell carcinoma development (8,9), especially sunburns occurring before age 20 (10–12). Children

seldom are adequately and consistently protected from the sun (13–16).

This paper reports on a 2-year evaluation of the *Sunny Days, Healthy Ways* sun safety instructional program (SDHW) for kindergarten through fifth grade. Multi-unit sun safety curricula can teach preschool and elementary school children about the importance of solar protection, produce supportive attitudes (3,4,17–21) and may increase preventive behavior (15,22). The SDHW was expected to increase knowledge and utilization of solar protection behaviors in all grades and attitudes in favor of solar protection and against tanning in second through fifth graders.

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METHODS

Target Population and Sample

Elementary schools in Tucson, Arizona were randomly selected for participation. Eligible schools had a minimum of 75% Caucasian students and classes in kindergarten through fifth grades. In four schools, 43 classes (with 42 teachers) were assigned at random to the single-instruction (group B) and no-instruction (group C) conditions: five kindergarten, one kindergarten/first grade combination, six first grade, two first/second grade, four second grade, one first/second/third grade, seven third grade, one third/fourth grade, six fourth grade, one fourth/fifth grade, and nine fifth grade classes. From six schools that had been enrolled in an earlier pilot-test of the SDHW, 35 classes (with 39 teachers) were re-enrolled to form the repeated-instruction condition (group A): eight first grade, nine second grade, five third grade, six fourth grade, and seven fifth grade classes.

A total of 1876 parents were mailed consent forms; data were provided only by children who both assented and had parental consent: 226 kindergarteners and first graders completed the pretest and 219, the posttest; 299 second and third graders completed the pretest and 283, the posttest; 268 fourth and fifth graders completed the pretest and 261, the posttest. Of these, 208 received the SDHW in two school years (group A, repeated-instruction), 227 children received the SDHW during a single school year (group B, single-instruction), and 207 students did not receive the SDHW (group C, no-instruction) and only completed the pretest and posttest surveys (see Table 1 for sample profile). No significant demographic differences among students in the three experimental conditions in grades 2–3 and 4–5 were found.

SDHW Instructional Program

Students in the single-instruction condition (group A) received the SDHW curriculum. Its instructional

objectives were to increase students' knowledge, teach them solar protection skills, produce positive changes in attitudes, and stimulate sun safety behavior. It contained three age-appropriate versions for kindergarten and first grade (K-1), second and third grades (2–3), and fourth and fifth grades (4–5), expanded from a version used previously (16,21,23). The main sun safety skills taught were limiting sun exposure during peak hours of daytime UVR (i.e., 10 A.M. to 3 P.M.), seeking shaded areas when outdoors, wearing protective clothing, applying sunscreen with an SPF of 15 or more, and asking their parents to help them practice sun safety. Each component contained four units—*Living with Sunshine*, *Limiting Time in the Sun*, *Wearing Cover-up Clothes*, and *Using Sunscreen*—designed to be taught in four 1-hour class periods. The instructional activities incorporated health, science, reading, mathematics, geography, physical education, art, computers, and writing. The grade K-1 component contained two storybooks and a limited number of activity sheets that taught curriculum content. Grade K-1 and 2–3 components included animated characters—the “Sun Safety Squad.” The components for grades 2–3 and 4–5 contained multiple activity sheets with activities, games, and puzzles; the 4–5 component included cards with UVR sensitive ink and activities using computers.

Booster units for grades 1, 3, and 5 in repeated-instruction condition For children in grades 1, 3, and 5 in the repeated-instruction condition (group A), three 2-hour age-appropriate “booster units” were developed so that these students received novel instructional materials in the second year. These consisted of interactive activities that included reviewing the main sun safety concepts and applying and reinforcing them in individual and small- and large-group activities.

Teacher training A 1.5-hour training session for teachers was conducted by the researchers. It consisted

TABLE 1. Demographic Characteristics of Children in Experimental Conditions

Characteristics	Grades 2–3			Grades 4–5		
	Repeated-instruction	Single-instruction	No-instruction	Repeated-instruction	Single-instruction	No-instruction
Sex (%)						
Male	42	47	51	58	46	61
Female	58	53	49	42	54	39
Ethnicity (%)						
White	75	71	71	71	72	77
Other	25	29	29	29	28	23
Skin sun sensitivity (mean)	0.33	0.073	0.084	0.059	0.19	0.12
Years living in Arizona (mean)	7.1	6.9	6.4	8.0	8.3	8.1

Children in kindergarten and grade 1 did not provide demographic characteristics.

of (a) an informational component including an overview of the project, rationale for conducting skin cancer prevention research, and a history of the SDHW; (b) a review of the research procedures component including obtaining student assent and teacher consent, teacher stipend payment, student test administration, and measurement of skin tone; and (c) a review of the SDHW curriculum component (by unit and activity), including a demonstration of all classroom activities. Training for the teachers in the no-instruction condition consisted of a review of consenting and testing procedures only.

Procedures

In classes assigned to the single-instruction condition, teachers taught the SDHW during a 6-week period starting in late February. Students in classes assigned to the repeated-instruction condition had received the SDHW curriculum during the spring semester of the previous school year. During the 6-week intervention period, teachers in grades 2 and 4 included in the repeated-instruction condition taught the full SDHW components for grades 2–3 and 4–5, while teachers in grades 1, 3, and 5 implemented the booster units. They presented the units consecutively and were told to complete all activities for each unit. All teachers completed a training session prior to implementation. After finishing a unit, teachers completed an activity checklist for that unit and mailed it back to the study office to monitor progress. Students were pretested during February, prior to implementation of the SDHW, and posttested in April and May after the intervention. Students in the repeated-instruction condition also were pretested prior to, and posttested after, receiving the SDHW in the previous school year.

Pretest and Posttest Measures on Students

Paper-and-pencil tests The pretest and posttest surveys for kindergarteners and first graders measured children’s knowledge of sun safety concepts using a four-item photographic test, a method validated by Loescher et al (19). It consisted of four pairs of colored photographs (labeled “A” or “B”) enlarged to poster size for easy display. Children were instructed to look at each pair of photographs and indicate on an answer sheet which photograph demonstrated the use of appropriate sun safety behaviors by circling “A” or “B.” For children in the single-instruction and no-instruction conditions, 11 simple written questions (reviewed by teachers for appropriateness), with dichotomous choices were added to the surveys to

increase the range and variability of responses. The number of correct answers to the test questions were summed to create the knowledge score.

For children in grades 2–5, pretest and posttest surveys measured children’s knowledge of the sun safety concepts, skills, and information taught in the SDHW curriculum (30-items for grades 2–3, 35-items for grades 4–5; answer options = “yes,” “no,” “don’t know”). Attitude measures (seven items for grades 2–3, 10 items for grades 4–5; answer range = “yes,” “maybe,” “no”) were summed into a single attitude score with higher scores indicating more favorable attitudes toward sun safety. Measures of 13 self-reported solar protection behaviors and eight protection behaviors by parents (answer range = “always,” “sometimes,” “never”) were summed into two scales with higher scores indicating more sun safe behavior. These scales were based on measures used earlier (15,20,22).

A few items comprising the knowledge scales in grades 2–3 and grades 4–5 differed between the repeated-instruction and the single-instruction and no-instruction groups, due to minor revisions in content in the grade-specific components from the pilot test to the field trial. Therefore, grade group- and year-specific means and standard deviations were calculated and used to transform the percent correct into *z*-scores.

The attitude items varied slightly between grades 2–3 and 4–5 but were consistent across years. Thus, attitude scores were standardized by transforming the mean of the responses to the attitude questions to *z*-scores using grade-specific means and standard deviations from the pretest scores.

Skin tone measure Children’s skin tone was measured at pretest and posttest using a colorimeter (22). Colorimeter measures of skin tone changes in response to UVR exposure have been validated clinically (23–25). Pre/post changes in the difference between the skin tone on the outside lower arm (exposed skin area) versus the inside upper arm (unexposed skin area) provided a measure of skin darkening due to sun exposure. Smaller values of these differences indicated less darkening of the skin and less exposure to UVR.

Statistical Analysis

The effects of the curriculum in both a single-instruction and repeated-instruction form on the change in knowledge, attitude, and behavior from pretest to posttest were analyzed using mixed-effects analysis of variance (ANOVA) appropriate for correlated repeated measures data (26). Grades 2–3 and 4–5 were analyzed within the

same model in order to determine the interaction of intervention with grade-group, if any. Due to the extreme differences between the K-1 test and the test for the other grades, K-1 children were analyzed separately. The intervention [two presentations of curriculum (group A), one presentation of curriculum (group B), and no curriculum (group C)] was considered a between-subjects factor. The “year” (year 1 vs year 2), “test” (pretest vs posttest), and “grade group” (2–3 vs. 4–5 for the grade 2–5 analysis only) variables were considered within-subjects factors. The modeled covariance structure allowed for potential correlation among all four assessments for children in intervention group A and between the two assessments for children in intervention groups B and C. In addition, it was assumed that the covariance for groups B and C would be equivalent to group A during their first year in the study. Contrasts were performed to test various hypotheses concerning the main effects and interactions. An experimentwise error rate of 0.05 was maintained by accounting for the multiple comparisons made for each outcome using sequential rejective Bonferroni procedures (27).

RESULTS

Manipulation Checks

In the pilot test where students in the repeated-instruction condition received their first exposure to the SDHW, 40% of K-1 teachers reported implementing all activities in all units (47%, Unit 1; 33%, Unit 2; 38%, Unit 3); 94% of 2–3 grade teachers reported implementing all activities in all units (100%, Unit 1; 100%, Unit 2; 75%, Unit 3; 100%, Unit 4); and 22% of 4–5 grade teachers reported implementing all activities in all units (33%, Unit 1; 37.5%, Unit 2; 0%, Unit 3; 14%, Unit 4).

In the main trial, 50% of kindergarten teachers reported implementing all activities in all units (100%, Unit 1; 50%, Unit 2; 50%, Unit 3; 0%, Unit 4). Ninety-three percent of the first grade teachers reported implementing all activities in all units (100%, Unit 1; 100%, Unit 2; 75%, Unit 3; 100%, Unit 4). For the second grade teachers, 73% reported implementing all activities in all units (71%, Unit 1; 57%, Unit 2; 67%, Unit 3; 100%, Unit 4). One hundred percent of the third grade teachers reported implementing all activities in all units (33%, Unit 1; 37.5%, Unit 2; 0%, Unit 3; 14%, Unit 4). Of the fourth grade teachers, 68% of teachers reported implementing all activities in all units (71%, Unit 1; 63%, Unit 2; 88%, Unit 3; 50%, Unit 4). Finally, 66% of fifth grade teachers reported implementing all activities in all units (100%, Unit 1; 66%, Unit 2; 100%, Unit 3; 0%, Unit 4).

Effect of Single Presentation of the SDHW

The effect of a single presentation of the SDHW was tested by comparing the change in outcomes from pretest to posttest between groups B (single-presentation) and C (no-instruction). We report the results from kindergarten and grade 1 separately from grades 2 to 5, because of differences in the measures.

Kindergarten–Grade 1 Kindergartners and first graders receiving a single presentation of the SDHW displayed a smaller increase in sun safety knowledge than those in the no-instruction control group, $t = -2.0$, $df = 202$, $p = 0.047$. A comparison of only their posttest scores revealed no significant difference between SDHW instruction and no-instruction conditions on knowledge ($p > 0.05$).

No significant differences were found between the two experimental groups in grade K-1 on changes in skin tone indicative of less sun exposure: light–dark (L^* ; $t = -0.44$, $df = 202$, $p = 0.659$), blue–yellow (b^* ; $t = 0.36$, $df = 202$, $p = 0.721$), or red scales (a ; $t = 0.12$, $df = 202$, $p = 0.908$).

Grades 2–5 Students receiving a single presentation of the SDHW in grades 2–5 showed the expected increase in sun safety knowledge compared with students in the no-instruction group, $t = 9.14$, $df = 474$, $p = 0.0001$ (see means in Table 2). There was no interaction with grade, $t = -0.68$, $df = 474$, $p = 0.497$.

A single presentation of the SDHW did not produce greater self-reported solar protection by children in grades 2–5, $t = 1.52$, $df = 471$, $p = 0.129$, in either grade (intervention \times grade: $t = -0.63$, $df = 471$, $p = 0.529$). It did not improve their reports of solar protection practiced by their parents, either, $t = -1.02$, $df = 4.73$, $p = 0.308$ (Table 2).

There was a little evidence that a single presentation of the SDHW affected children’s exposure to UVR as measured by the colorimeter in grades 2–5. In grades 2–5, neither the L^* scale ($t = -0.61$, $df = 464$, $p = 0.541$) nor the a scale ($t = -0.69$, $df = 464$, $p = 0.490$) indicated pre/post differences between the single-instruction and no-instruction conditions. A near-significant difference was found between the two groups in grades 2–5 on the b^* scale ($t = -1.82$, $df = 464$, $p = 0.0697$), with single-instruction children showing less darkening of their skin tone than no-instruction children (Table 2).

Finally, in grades 2–5, there was no significant effect of the SDHW on children’s attitudes toward sun safety, $t = 0.91$, $df = 474$, $p = 0.363$ (intervention \times grade: $t = -0.96$, $df = 474$, $p = 0.339$).

TABLE 2. Mean Pretest and Posttest Scale Scores for Students in Single-Instruction and No-Instruction Conditions

Scale	Condition	Grade	Pretest	Posttest
Knowledge*	Single-instruction	K-1†	3.71	3.90
		2-3	-0.09	1.17
		4-5	-0.04	1.31
	No-instruction	K-1	3.30	3.79
		2-3	0.11	0.40
		4-5	0.03	0.25
Attitude*	Single-instruction	2-3	0.06	0.18
		4-5	0.13	0.25
		2-3	-0.25	-0.13
	No-instruction	4-5	-0.08	-0.14
		2-3	2.09	2.08
		4-5	2.00	2.01
Child Solar Protection*	Single-instruction	2-3	1.99	1.96
		4-5	1.95	1.89
		2-3	2.04	1.92
	No-instruction	4-5	1.98	1.97
		2-3	1.91	1.85
		4-5	1.80	1.82
Parent Solar Protection*	SDHW-instruction	K-1	-5.76	-7.66
		2-3	-6.85	-8.89
		4-5	-7.68	-9.86
	No-instruction	K-1	-5.48	-7.16
		2-3	-6.61	-8.56
		4-5	-7.95	-9.89
Chroma Meter (L^*)‡	Single-instruction	K-1	4.26	5.26
		2-3	5.18	5.71
		4-5	5.48	6.17
	No-instruction	K-1	4.30	5.18
		2-3	4.66	5.58
		4-5	5.52	6.43
Chroma Meter (b^*)§	Single-instruction	K-1	2.77	3.72
		2-3	3.22	3.89
		4-5	3.56	4.27
	No-instruction	K-1	2.56	3.48
		2-3	3.14	3.85
		4-5	3.75	4.67

*On all written scales, higher scores indicated more sun safety knowledge, a more favorable attitude, or more frequent solar protection behavior.

†For grades K-1, means indicate number of correct out of four items; for grades 2-5, means are based on a standardized score for knowledge, because number of knowledge items varied across grades.

‡Lower scores on the L^* scale indicate more skin darkening and more exposure to ultraviolet radiation.

§Higher scores on the b^* scale indicate more skin darkening and more exposure to ultraviolet radiation.

¶Higher scores in the a scale indicate more skin redness and more exposure to ultraviolet radiation.

Effect of Repeated Presentation of the SDHW

The effect of the repeated instruction was tested by comparing the change in outcome from pretest (year 1) to posttest (year 2) between group A (those receiving the curriculum over 2 years) and pretest–posttest change (year 2) for group B (those receiving the curriculum in the second year only). Also examined was the change in outcomes for those in group A from pretest (year 1) to posttest (year 2) compared with their change over year 1 (from year 1 pretest to year 1 posttest). Once again, we report the results for kindergarten and grade 1 separately from grades 2 to 5.

Pretest equivalence of repeated-instruction (A) and single-instruction (B) groups

Comparison of the pretest

scores between students in the three conditions collected showed that the groups were not significantly different on sun safety knowledge (grades K-1: $t = 1.68$, $df = 202$, $p = 0.095$; grades 2-5: $t = -0.68$, $df = 474$, $p = 0.496$) or attitudes related to sun safety (grades 2-5: $t = -0.02$, $df = 474$, $p = 0.982$) when they entered the study. In grades 2-5, self-reported solar protection, $t = 2.06$, $df = 471$, $p = 0.040$, and reported parent solar protection, $t = 2.69$, $df = 473$, $p = 0.007$, were slightly higher in the repeated-instruction group at baseline than among students in the single-instruction and no-instruction groups. In grades 2-5, students in the repeated-instruction condition had darker skin tones at pretest (lower L^* scores, $t = 2.18$, $df = 464$, $p = 0.030$; higher b^* scores, $t = 2.44$, $df = 464$, $p = 0.015$; higher a scores, $t = 2.76$, $df = 464$, $p = 0.006$) than in the single-instruction and

no-instruction groups. There was no difference in pretest skin tone measures in grades K-1 (L^* scale, $t = 0.89$, $df = 202$, $p = 0.377$; b scale, $t = 0.88$, $df = 202$, $p = 0.378$; a scale, $t = 0.76$, $df = 202$, $p = 0.447$).

Kindergarten–Grade 1 Repeated exposure to the SDHW did not improve sun safety knowledge of kindergarteners and first graders in group A, either when compared with those receiving one exposure (group B), $t = 0.90$, $df = 202$, $p = 0.369$, or when scores following the first and second exposure were compared within group A students, $t = 0.97$, $df = 202$, $p = 0.333$ (see means in Table 3).

Children in kindergarten and first grade showed no change in skin tone due to repeated SDHW instruction, L^* , $t = 0.20$, $df = 202$, $p = 0.843$, b^* , $t = -1.34$, $df = 202$, $p = 0.183$, and a scales, $t = -0.54$, $df = 202$, $p = 0.593$, when compared with the single-instruction condition. Comparisons of changes across years within the repeated-instruction group also were nonsignificant ($p > 0.05$).

Grades 2–5 Repeated exposure to the SDHW improved children's sun safety knowledge in grades 2–5, both in comparison to their own change following their first exposure, $t = 2.08$, $df = 474$, $p = 0.0381$, and to the

pre/post change in students in the single-instruction condition, $t = 3.53$, $df = 474$, $p = 0.0005$ (Table 3). The former test becomes nonsignificant following Bonferroni correction.

In grades 2–5, a second exposure to the SDHW improved children's self-reported solar protection over a single exposure (repeated-instruction versus single-instruction: $t = 2.22$, $df = 471$, $p = 0.026$). The difference in self-reported solar protection occurred primarily in grades 2–3 (repetition \times grade: $t = 2.22$, $df = 471$, $p = 0.027$). Both effects, though, did not remain significant when applying the Bonferroni adjustment (Table 3). However, there were no significant dose effects for changes in these children's reports of the extent to which their parents protected them from the sun ($p > 0.05$).

Likewise, children in grades 2–5 who received repeated instruction displayed lighter skin tones, indicating lower exposure to UVR, than children receiving only one presentation of the SDHW (see Table 3 for means). On the L^* scale, children in the repeated-instruction group had smaller changes when compared with children in the single-instruction group, $t = 3.89$, $df = 464$, $p = 0.0001$. The reduced UVR exposure among children in the repeated-instruction group also was confirmed on the b^* scale. Children in the repeated-instruction group showed smaller increases in skin darkening when compared with

TABLE 3. Mean Pretest and Posttest Scale Scores after the First and Second Exposures to the SDHW for Students in the Repeated-Instruction Condition

Scale	Grade	First exposure*		Second exposure	
		Pretest	Posttest	Pretest	Posttest
Knowledge†	K-1	3.68	3.94	3.90	3.98
	2-3	-0.04	1.28	1.21	1.93
	4-5	-0.12	1.75	0.80	1.51
Attitude†	2-3	0.02	0.22	0.45	0.51
	4-5	-0.10	0.01	-0.02	0.07
Child Solar Protection†	2-3	2.09	2.17	2.19	2.27
	4-5	2.05	2.05	2.02	2.05
Parent Solar Protection†	2-3	2.11	2.12	2.17	2.24
	4-5	2.03	1.92	1.91	1.96
Chroma Meter (L^*)‡	K-1	-5.31	-6.49	-6.01	-7.12
	2-3	-6.98	-7.28	-7.05	-8.75
	4-5	-8.90	-10.20	-7.86	-9.12
Chroma Meter (b^*)§	K-1	4.49	4.73	4.94	5.11
	2-3	5.67	5.84	5.26	5.80
	4-5	5.80	6.28	5.69	6.06
Chroma Meter (a)¶	K-1	2.51	3.43	2.74	3.31
	2-3	3.14	3.43	3.43	3.97
	4-5	4.79	4.83	3.67	4.33

*First exposure refers to tests for SDHW curriculum implementation in Spring 1996; second exposure refers to tests for SDHW curriculum implementation in Spring 1997.

†On all written scales, higher scores indicated more sun safety knowledge, a more favorable attitude, or more frequent solar protection behavior.

‡Lower scores on the L^* scale indicate more skin darkening and more exposure to ultraviolet radiation.

§Higher scores on the b scale indicate more skin darkening and more exposure to ultraviolet radiation.

¶Higher scores in the a scale indicate more skin redness and more exposure to ultraviolet radiation.

children receiving only a single presentation of the SDHW, $t = -1.95$, $df = 464$, $p = 0.052$. Finally, there was far less increase in the redness (a scale) of the skin of children in the repeated-instruction group, indicating less erythema, compared with children in the single-instruction group, $t = -2.26$, $df = 464$, $p = 0.0243$ (this test was nonsignificant when applying the Bonferroni adjustment) (see means in Table 3).

A second exposure to the SDHW had little impact on children's attitudes in grades 2–5 (repeated-instruction vs single-instruction: $t = 1.42$, $df = 474$, $p = 0.158$; one vs two exposures within repeated-instruction group: $t = 1.43$, $df = 474$, $p = 0.152$). The repeated-instruction group expressed more favorable attitudes than the no-instruction group, $t = 1.97$, $df = 474$, $p = 0.050$ (Table 3).

DISCUSSION

The immediate effects of the SDHW were limited to improving children's sun safety knowledge. Knowledge gains have been the most consistent outcome of the SDHW (15,20,22) and in the majority of childhood sun safety interventions (13,17). The current results suggest that direct education of very young children may not be very beneficial, even though a study on preschool-aged children reported improved recall and comprehension (19). It is possible that the knowledge test for grades K-1 was not sensitive enough or had a ceiling effect that reduced the ability to detect knowledge changes. However, programs directed to parents and caregivers may be effective alternative strategies for promoting sun safety of very young children (13,17,28–34).

The lack of immediate improvements in sun safety attitudes and solar protection behavior after a single exposure to the SDHW was inconsistent with previous evaluations (15,20,22). Past evaluations of multiunit programs suggested that they can improve attitudes and solar protection (13,17). Children in primary schools may require time to internalize and put the sun safety skills into practice (20). This might explain why the SDHW produced a broad range of favorable sun safety outcomes when taught to children a second time (a total of 6 hours of instruction). With repeated exposure, students in grades 2–5 continued to experience substantial gains in sun safety knowledge. Most importantly, children in grades 2–5 receiving two exposures to the SDHW reported engaging in more solar protection behaviors and according to colorimeter assessments, showed less skin darkening indicating less exposure to UVR. However, this outcome is tempered by the nonequivalence of these measures at baseline. The results imply that continuing sun safety education

is essential for achieving improvements among children in grades 2–5.

LIMITATIONS

Several of the measures used in this study were self-reports by children, which can be influenced by social desirability and demand effects. The colorimeter provided an observational measure of UVR exposure, although this mechanical measure is not without some drawbacks (17). It is difficult to directly validate attitude scales because there is no external objective criterion. The best alternatives are to establish face and construct validity (35). While colorimeter measures are more objective, they are subject to reliability errors. We did not obtain reliability measures in this project, although in a later study we showed that intraclass correlations within readings obtained by operators ranged from 0.08 for the b^* scale to 0.74 for the a scale (36).

The test of repeated instruction is open to the effects of history, because students in the repeated-instruction condition were pretested a year earlier than the students in the other two conditions. Fortunately, pretest differences between the groups appeared to be small. There is also the possibility of a seasonality effect because pretesting occurred each year in the winter and posttesting in the spring, a period when sun intensity and average temperatures are increasing. However, this seasonality was occurring in all experimental groups and differences observed occurred despite seasonal trends that would produce more potential to sunburn and possibly lead to wearing lighter or less clothing. Finally, the first implementation of the SDHW and/or the testing may have sensitized children to sun safety information. An earlier evaluation of the SDHW showed that pretesting only increased children's recognition of terminology in the instructional materials, not their other self-reports.

SUMMARY

Sun safety of children continues to be a national (37,38) and international priority (39). Direct instruction of children using multiunit school-based instruction in the elementary school grades should be included as one component in comprehensive community-wide programs to improve sun protection (13,17,40). The findings underscore the recent recommendation by the U.S. Centers for Disease Control and Prevention that schools provide sun safety instruction routinely over several years (38). Skin cancer prevention experts and programmers face increasing challenges in convincing schools to adopt these instructional materials, including mandates for standard-based education and student

testing of students and declining resources. It is also essential to employ effective strategies to make school officials aware of evidence-based skin cancer curricula and to convince them to adopt them (41). School health educators should also consider alternatives such as policy changes and communications with parents and students outside of the school day (27,28,42).

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