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"Live Sun Smart!" Testing the effectiveness of a sun safety program for middle schoolers

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Abstract

Background: Skin cancer is a well-recognized public health issue, and primary prevention is the most effective strategy for reducing skin cancer risk. The current recommendations are that behavioral counseling for sun safety measures is most beneficial and effective for children and adolescents and that targeting this population at primary and middle schools is the ideal intervention strategy to increase sun-protective behaviors and reduce UV exposure, sunburn incidence, and formation of new moles. Numerous studies on the effectiveness of school-based sun safety interventions among elementary and middle school students have shown an increase in sun safety knowledge, attitudes, and behaviors following the intervention.

Objective: To conduct a pilot feasibility study of "Live Sun Smart!," (LSS) a school-based, multicomponent, interactive sun safety presentation, at changing sun safety knowledge, attitudes, and behaviors among middle school students.

Methods: A non-randomized, single-group pretest-posttest interventional pilot study of the LSS program among children enrolled in grade 6.

Results: After exposure to LSS, participants were more likely to give correct answers to knowledge-based sun safety questions and to report negative attitudes toward tanning. Minimal and not significant changes were found in self-reported sun safety behaviors, though students did report an intention to change behaviors following the intervention. Participants were satisfied with the program and believed it increased their sun safety knowledge.

Conclusion: Live Sun Smart! appears to be an effective school-based, multicomponent sun safety program for improving sun safety knowledge and attitudes toward tanning among middle school students in this initial test of it. The strengths and weaknesses of this pilot study have implications for future research.

KEYWORDS

adolescents, health education, melanoma, middle school, prevention, skin neoplasms, sun safety, tanning

1 | INTRODUCTION

Exposure to ultraviolet radiation (UVR) during childhood and adolescence plays an important role in the later development of skin cancer.[1] Primary prevention is the most effective strategy to reduce the risk of skin cancer, and reducing severe excess UVR exposure before age 20 can substantially lower the risks for both non-melanoma skin cancers and melanoma.[2] Because at least 25% of a person's lifetime UVR exposure occurs during childhood, elementary and middle school-aged children are ideal targets for intervention programs. These children spend

an average of 20 hours a week outdoors, 10 of which are during school, often when the sun is at its peak intensity.[3,4]

Currently, the USPSTF recommends counseling fair-skinned people aged 10-24 on the risks of skin cancer.[5] The CDC has issued guidelines recommending that schools participate in skin cancer prevention activities and policies.[6] Schools are considered an appropriate venue for delivering sun safety messages, as they provide the opportunity to reach a large population of children and often already have a health curriculum in place.[6]

A 2004 systematic review by Saraiya et al[7] evaluated the effectiveness of educational and policy interventions in elementary and middle schools to improve sun-protective knowledge, attitudes, and behaviors. The review covered interventions to impart and improve knowledge, to change attitudes or behaviors, or to change environmental and policy approaches, and it found that the majority of interventions resulted in significant improvements in sun safety knowledge and attitudes among participants.

The objective of this study was to develop a new educational, multicomponent, school-based pilot intervention, called *Live Sun Smart!* (LSS), focused on sun safety and to evaluate its effectiveness at improving sun safety knowledge, attitudes, and behaviors of middle school students by conducting a pilot test of it in one middle school.

2 | METHODS

2.1 | Study population

The defined target population for the study was grade 6 students enrolled in a private middle school in North Carolina. We used a convenience sample to identify three potential schools, securing the participation of one of them. The study sample included 106 grade six students.

2.2 | Study design

We conducted a three-week, non-randomized, one-group pretest-posttest pilot intervention trial of the LSS program among children enrolled in grade 6 following institutional review board approval (IRB # 18-3069). The intervention included an in-class presentation and two weeks of sun safety electronic messages. The in-class component was a 30-minute interactive, educational presentation and a sunscreen application demonstration using a live-action UV camera. Students then received electronic messages with sun safety infographics three times a week for 2 weeks. All program components are available from the authors on request.

2.3 | Data collection and variables

Data on **the** primary outcomes, sun safety knowledge, attitudes, and behaviors, were collected through anonymous, web-based pre- and post-intervention questionnaires delivered to students via their school email addresses. We developed these new, not yet validated pre- and post-intervention questionnaires surveys using an age-appropriate and evidence-based curriculum for this pilot study. The surveys were administered two weeks apart. The 35-item pre- and post-questionnaires contained a variety of questions aimed at assessing self-reported knowledge about, attitudes and perceptions toward, and behaviors for sun safety and sun safety practices (Table 1). The post-questionnaire asked additional questions to ascertain overall satisfaction with the LSS program, students' self-assessment of their knowledge gain, and their intent to change behavior. Participants were also asked to indicate their age, gender, and degree of skin sensitivity to UV exposure, which was used as a proxy for Fitzpatrick skin types I-VI, where types I and II and types III to VI were denoted as "high risk" and "low risk" skin types, respectively.[8] We used three non-identifiable "password recovery" type questions in both pre- and post-intervention surveys to create individual-level paired responses.

2.4 | Statistical analysis

All statistical analyses were performed using Stata/MP 15.0.[9] A paired-sample *t* test across all individual questions and total outcome summary scores was used to detect mean differences in responses. A paired sample *t* test was also used to detect a mean difference in total outcome scores across genders and categories of Fitzpatrick skin type. For questions assessing students' satisfaction with the LSS program, we calculated item means from the total post-sample. A two-sided *P* value < .05 was considered significant.

TABLE 1 Demographic profiles of respondents from pair-matched sample

Variable	Frequency (%)
Total	57
Age, mean (SD), y	11.7 (0.5)
Gender	
Male	50.9
Female	49.1
Other	0
Skin sensitivity	
Always burn, never tan	1.6
Burns easily, barely tans	7.4
Sometimes burns, sometimes tans	37.0
Burns a little, always tans	14.8
Barely burns, tans easily	20.4
Never burns, always tan and dark	18.5

3 | RESULTS

3.1 | Profile of sample

Of a possible pool of 103 consented students, we were able to match 56 sets of pre- and post-intervention responses. The sample of participants used for the pair-match analysis had a mean age of 11.7 and consisted of a slight male majority (Table 1). The most common skin sensitivity type among the paired sample was Fitzpatrick Type III, at 37%.

3.2 | Knowledge, attitudes, and behavior

The intervention was associated with an increase in total knowledge score ($P < .001$), while total attitude and behavior scores did not change significantly following the intervention (Table 2). Table 3 presents all individual items assessing primary outcomes and summarizes mean differences between time points and statistical significance of each paired-sample *t* test. Respondents' disagreement with the statement, "when I am tan, I look healthier and more attractive" significantly improved after the intervention ($P = .05$). Of the remaining items assessing attitude, many saw declines in favorable attitudes toward sun safety and sun safety practices, although these changes were not significant. Although all self-reported behaviors except wearing long-sleeved tops improved following the intervention, there was no significant difference for any individual item assessing self-reported sun safety behaviors. Notably, the reported use of sunscreen when playing outside sports or during outdoor activities was consistently lower than when at the beach or pool. Self-identified males and females did not differ significantly in mean differences for total knowledge, attitude, or behavior scores, nor did Fitzpatrick skin type differentiate among mean knowledge, attitude, or intended behavior difference.

Of the sample of students who responded to the post-questionnaire, a majority of students reported satisfaction with the LSS program and preferred the in-class portion over the email infographics. Their favorite portion of the presentation was the UV camera demonstration because it was interactive and was an interesting and strongly visual way to learn about how sunscreen protects them.

TABLE 2 Mean score differences for pre- and post-questionnaire responses on total outcome scores for sun safety knowledge, attitude, and behavior for pair-matched sample

	Mean difference	*P* value
Total Knowledge Score[a]	0.20	<.0001
Total Attitude Score[b]	1.28	.6364
Total Behavior Score[c]	0.10	.1463

[a]Scored on a (0-1) scale, where "1" denotes knowledge of sun safety.

[b]Scored on a (0-100) scale, where "0" denotes the most positive sun safety attitude.

[c]Scored on a (1-5) scale, where "5" denotes always practicing sun safety behaviors.

The majority of students (73.2%) felt their sun safety knowledge improved following the LSS program. A majority of students reported in the post-intervention survey that they would seek shade more often (69.1%), increase their use of sunscreen with SPF > 30 (87.3%), and wear sunglasses more often (61.8%) in order to protect themselves when outside.

4 | DISCUSSION

The results of this initial pilot study of a new middle school sun safety intervention indicate that LSS resulted in improved overall sun safety knowledge and resulted in some improvement in sun safety attitudes among study participants. Self-report of short-term sun safety behaviors did not significantly change, and there were no significant changes in any total outcome scores across gender or Fitzpatrick skin type. The most robust change occurred in the improvement of knowledge about the risks of peak UVR hours and situations. These findings are in agreement with previous studies that demonstrated the effectiveness of sun safety interventions at changing sun safety knowledge and attitudes, with less effective changes for sun safety behaviors.[10,11]

Although the findings from this pilot study of a new intervention are modest, they did produce useful information about how this specific population of students responded to and received a health education program. The LSS program appeared to be associated with change in some individual sun safety knowledge items as well as with the total knowledge score. In the context of what were virtually ceiling effects for many of the knowledge questions, it is not surprising that there were not more robust changes in knowledge. In the free-response section of the program satisfaction questions, several students said their knowledge only mildly improved, if at all, because they already felt they had high levels of sun safety knowledge.

One of the major challenges of skin cancer prevention efforts is that high-risk sun behaviors often occur despite parents and children being knowledgeable about the risks of UVR and overexposure.[12] Despite the study group's high knowledge of sun safety, the reported use of sunscreen during outdoor sports and activities was consistently lower than use during beach or pool activities. Prevention programs should not rely on merely improving esoteric knowledge about the topic of sun safety, but should deliberately connect these learning points to specific changes in attitudes or behaviors. The ultimate goal of LSS was to use background sun safety knowledge to elevate the students' understanding of how this knowledge can help mitigate their risks for skin cancer and help them live healthier lives.

Two of the most important points addressed in this program were the "healthy glow" fallacy of tanned skin and the dangers of indoor tanning. While the state in which this pilot study was conducted regulates minors' use of tanning beds, reducing students' risk from this behavior, it is important to normalize the dangers of indoor tanning beds early in adolescence. The LSS program successfully discouraged endorsement of the "healthy glow" fallacy. While the results showed no significant changes in short-term

TABLE 3 LSS questionnaire and mean score difference for pre- and post-questionnaire responses

Primary outcome	Questionnaire item	Question style	Minimum score[a]	Maximum score[a]	Mean difference
Knowledge	Lying out in the sun is not bad for me right now. I only need to worry about that when I'm older.	(0-100) Continuous Scale	***(0) Strongly Disagree***	(100) Strongly Agree	−5.84
	Being sunburned isn't a big deal, because it turns into a tan anyways.	(0-100) Continuous Scale	***(0) Strongly Disagree***	(100) Strongly Agree	−9.59[c]
	How often should SPF 30 sunscreen be reapplied when you're in the sun?	Multiple Choice, Dichotomous	(0) Incorrect	***(1) Correct***	0.05
	When should we be worried about getting sunburned?	Multiple Choice, Dichotomous	(0) Incorrect	***(1) Correct***	0.09[c]
	Using a tanning bed _____ time(s) can increase my risk for skin cancer.	Multiple Choice, Dichotomous Scale	(0) Incorrect	***(1) Correct***	0.25[c]
	Having a tan protects my skin from the sun.	True/False	(0) True	***(1) False***	0.09
	I should stay out of the sun if my shadow is shorter than my body.	True/False	(0) False	***(1) True***	0.47[c]
	If I use sunscreen, I can tan without harming my skin.	True/False	(0) True	***(1) False***	0.18[c]
	Ultraviolet rays, called UV rays, can cause skin cancer.	True/False	(0) False	***(1) True***	−0.05
	Ultraviolet rays, called UV rays, can make people's skin look old.	True/False	(0) False	***(1) True***	0.12[c]
	A spray-on tan protects my skin from the sun.	True/False	(0) True	***(1) False***	0.02
	UV rays from tanning beds are safer than the UV rays coming from the sun.	True/False	(0) True	***(1) False***	0.18[c]
Attitude	When I am tan, I look healthier and more attractive.	(0-100) Continuous Scale	***(0) Strongly Disagree***	(100) Strongly Agree	−9.08
	Why do you use sunscreen?[b]	(0-100) Continuous Scale			
	Because your parents/teachers want you to?		(0) Does not describe me	(1) Describes me extremely well	−0.42
	To avoid sunburns?		(0) Does not describe me	(1) Describes me extremely well	1.6
	To prolong the time you can be in the sun?		(0) Does not describe me	(1) Describes me extremely well	−3.87
	To avoid later skin damage?		(0) Does not describe me	(1) Describes me extremely well	3.02
	Below are some reasons why we may not protect ourselves when we're in the sun.				
	I only like to wear sunscreen when I'm at the beach or outside for a really long time.	(0-100) Continuous Scale	***(0) Does not describe me***	(100) Describes me extremely well	3.28
	I don't like the way sunscreen feels on my skin.	(0-100) Continuous Scale	***(0) Does not describe me***	(100) Describes me extremely well	2.62
	I don't like wearing hats.	(0-100) Continuous Scale	***(0) Does not describe me***	(100) Describes me extremely well	−1.70
	It's not cool to put sunscreen on.	(0-100) Continuous Scale	***(0) Does not describe me***	(100) Describes me extremely well	0.89
	I just forget sometimes.	(0-100) Continuous Scale	***(0) Does not describe me***	(100) Describes me extremely well	6.13

(Continues)

TABLE 3 (Continued)

Primary outcome	Questionnaire item	Question style	Minimum score[a]	Maximum score[a]	Mean difference
Behavior	**Think about spending time outdoors on a sunny day. If you're outside for more than 45 min, do you…**	(0-100) Continuous Scale			
	Wear sunscreen with "SPF 30" or higher?		(0) I never do this	***(100) I do this pretty much all the time***	2.15
	Wear a wide-brimmed hat?		(0) I never do this	***(100) I do this pretty much all the time***	2.20
	Wear a hat that is not wide-brimmed (example: baseball cap)?		(0) I never do this	***(100) I do this pretty much all the time***	0.75
	Wear sunglasses?		(0) I never do this	***(100) I do this pretty much all the time***	4.21
	Wear a long-sleeved top to cover your arms?		(0) I never do this	***(100) I do this pretty much all the time***	−4.4
	Try and stay in the shade?		(0) I never do this	***(100) I do this pretty much all the time***	3.02
	How often do you put sunscreen on when you…	5-point Likert Scale			
	Go to the beach?		(1) Never	***(5) Always***	0.16
	Go to the pool?		(1) Never	***(5) Always***	0.02
	Go to school in the morning?		(1) Never	***(5) Always***	0.23
	Play sports outside?		(1) Never	***(5) Always***	0.15
	Have outdoor school activities?		(1) Never	***(5) Always***	0.24
	Think about your upcoming summer plans. On a normal week, about how many days per week do you plan on lying out in the sun to get tan?	(0-5) Continuous Scale	(0) Every day of the week	***(5) I do not plan on lying out in the sun***	−0.15
	Think about LAST summer. How many sunburns did you get that caused you to blister and peel?[b]	(0-5) Continuous Scale	(0) More than 3	***(5) None***	

[a]Where the ideal sun safety behavior is bolded and italicized.

[b]Where responses are for qualitative analysis and not scored.

[c]Indicates a significant difference between pre- and post-questionnaire responses.

behaviors, a significant portion of the students reported intent to increase their sunscreen use on the post-intervention questionnaire. This is additionally relevant, as the program was timed to coincide with seasonal changes applicable to sun safety, for example, prior to summer break for southern states, in order to maximize potential benefit.

Although school-based interventions are considered the ideal setting for prevention efforts, technology provides an avenue for continuing the education outside the classroom walls. An integral component of LSS was the use of technology to deliver program materials. Using technology in sun safety interventions can further engage students in multimedia education styles and can release sun safety programs from the time constraints on health education during school calendar days.[13,14]

While the learning tools within LSS are similar to other widely available evidence-based curricula, including the Environmental Protection Agency established SunWise program[15] and the University of Texas MD Anderson Cancer Center® Ray and the Sunbeatables curriculum,[16] one major success of this study was that the program was created for and tailored to both the age of the study population and the resources available in the setting. Limitations of this study include the lack of a validated survey instrument and lack of a control group. It is likely that convenience sampling contributed to selection bias, thus all statistics should be interpreted with caution. Further, the private school that participated in this study has an annual tuition upwards of $23 000 and thus represents a discrete subpopulation of the middle school students in the state. These limitations make it difficult to conclude that the results of this study

are representative of the general middle school population. School calendar and curricula constraints limited the longitudinal component of the study to two weeks. Despite these limitations, the results of this study present an initial assessment of students' reactions to a pilot program and are a promising starting point for developing, tailoring, and expanding sun safety programs for middle school students.

Future studies will build on the strengths of this program and attempt to use these initial findings to improve the curriculum. An ideal study might have students receiving as much as four months of weekly LSS infographics with one-, two-, and four-month follow-up surveys. Prolonged school-based programs produce more robust changes in sun safety knowledge, attitudes, and behaviors and more long-term retention of such changes than do single-component programs.[17,18]

5 | CONCLUSION

This pilot study of the LSS pilot program showed a significant improvement in overall sun safety knowledge and some significant changes in sun safety attitudes among participants, but the study did not find significant changes in sun safety behaviors. This study adds to a body of research that has shown the importance of school-based sun safety programs. Programs like LSS have the potential to help reduce the burden of skin cancer, and skin cancer prevention programs should remain a priority in health education. By providing sun safety education to middle school students, we hope to create a culture of sun safety that will reduce the incidence of skin cancer.

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