Multi-Institutional Study Evaluating the Efficacy of SPOTS (Sun Protection Outreach Teaching by Students), a Skin Cancer Prevention Educational Program for Adolescents

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BACKGROUND The Sun Protection Outreach Teaching by Students (SPOTS) program previously demonstrated benefits to adolescents and medical students in the Midwest. Six years later, there have been significant program enhancements and geographic outreach has expanded.

OBJECTIVE This multi-institutional program evaluation study sought to quantify the efficacy of the enhanced SPOTS program in improving skin cancer knowledge, sun-safe attitudes, and sun protection behaviors in adolescents living in multiple geographic regions of the United States.

MATERIALS AND METHODS Surveys assessing students' knowledge, attitudes, and behaviors concerning skin cancer and sun protection were administered before and 1 month after SPOTS teaching.

RESULTS Analysis of 1,508 pre-program and 969 post-program surveys revealed statistically significant improvements in adolescents' knowledge, attitudes, and behaviors regarding sun protection. Notably, there was a 34.3%, 107.5%, and 27.1% relative improvement in the percentage of students' sunscreen protection factor knowledge, belief that a tan is unhealthy, and intention to wear sunscreen, respectively ($p < .001$). In addition, 57.6% of students reported having tried to increase sunscreen usage after SPOTS. Subgroup analyses demonstrated similar improvements across Fitzpatrick skin-types and across different geographic regions.

CONCLUSION The enhanced SPOTS program demonstrated significant improvements in adolescents' knowledge, attitudes, and behaviors toward sun protection.

Skin cancer is the most common type of cancer in the United States,[1,2] with an estimated 5.4 million nonmelanoma skin cancer[3] and 100,000 melanoma diagnoses annually.[4] Ultraviolet radiation (UVR) is the single most preventable risk factor for developing skin cancer,[5–8] with both cumulative lifetime and adolescent sun exposure being correlated.[7,8] Sun exposure is highest for individuals before the age of 21 years,[9,10] and blistering sunburns early in life are associated with an increased hazard ratios (HRs 1.44) for future melanoma.[8] A 2022 survey study of college-aged students found that 53% reported intentional outdoor tanning, with 46% having had a sunburn in the past 3 months.[11] These trends highlight the critical need for sun protection education in young populations before skin damage is obtained.

Due to adolescence being a high-risk time for UVR exposure, schools are a prime location for educational interventions as recommended by the US Community

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Obtained on an "opt-out" basis, as approved by all institutions Institutional Review Boards, in which parents of all participants were offered the opportunity for their children to opt-out of this survey study. Individual student participants provided verbal consent for their participation in the survey study on the date of participation, in addition to the "opt-out" parameters outlined here.

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Preventative Services Task Force.[12,13] However, there remains an unmet need for this school-based education, with only the minority of public high schools in the United States offering sun protection curricula.[14] For schools that do have sun protection education, positive impacts have been reported.[15] Efforts have been made to evaluate the various sun protection outreach programs.[15–18] However, there is a lack of studies on how a single sun protection program performs across broader geographic regions.

In 2006, the Sun Protection Outreach Teaching by Students (SPOTS) program was created as a collaborative effort by the melanoma advocacy organization, academic dermatology physician faculty, and medical students at 2 medical schools. SPOTS is a community outreach program in which the dermatology faculty train medical students to teach adolescents about skin cancer prevention and early detection. The SPOTS program implements an interactive multimedia curriculum about sun protection that can be taught in a 1-hour classroom setting. Given that teens are highly driven by appearance,[19–21] SPOTS utilizes both health-based and appearance-based motivators for sun protection and tanning avoidance. SPOTS incorporates a "black light" machine to show students the sun damage they have already accumulated on their own skin, which can improve program efficacy.[22–24] Because adolescents are significantly influenced by peers,[15,25] the program incorporates a video of 2 teenagers telling their personal story with melanoma and deploys medical students as SPOTS teachers. SPOTS has now expanded across the United States with 60+ medical schools having SPOTS chapters.

A previously published survey study evaluating the effectiveness of the SPOTS program in eighth grade students found significant improvements in adolescents' knowledge, attitudes, and behaviors toward sun protection.[18] However, the data were limited in being a single institution study.

Since the prior SPOTS study's data collection in 2016 to 2018, significant strides have been taken to improve the program. Most notably, there has been a significant increase in photos and information throughout that illustrate skin cancer in individuals with skin of color (SOC). A recent review found that teaching with melanoma photographs on SOC has the potential to enhance identification and early detection of skin cancer in non-White populations.[19,20] Despite this, there is an absence of skin cancer in SOC images in some current national sun protection and skin cancer education campaigns,[17,26] highlighting an unmet need. In addition, with the help of an educational grant in 2019 by the American Skin Association, SPOTS has been able to work with a health literacy partner to optimize age-appropriateness of materials, develop educational take-home materials, and enhance student engagement.

The authors sought to evaluate the effectiveness of the updated SPOTS program through a new multi-institution study. The purpose of this research was to quantify the impact of SPOTS on adolescents' knowledge, attitudes, and behaviors regarding sun protection across multiple geographic regions in the United States.

Methods

The study utilized a survey methodology to assess adolescent students' knowledge, attitudes, and behaviors concerning skin cancer and sun protection before and after receiving the SPOTS program. Pre-program and a 1-month post-program surveys were designed primarily using previously published studies on sun protective programs, including the SPOTS program.[18,27] Institutional Review Board (IRB) approval for this survey study was obtained in June of 2022.

Medical schools with active SPOTS chapters were recruited to contribute data to this study. Each of these medical schools underwent a similar IRB approval process, obtaining permission from their university's IRBs to contribute data to this multi-institutional study. Initially medical schools representing all US geographic regions were recruited and started the process of obtaining approval. Five medical schools were able to obtain all consents and were located in the Midwest, South and Western regions of the United States. After IRB approval, research team members from each institution then recruited middle and high schools (termed "partner schools"), which were already receiving SPOTS programming for involvement in the study. All parents of students receiving SPOTS education were given an "opt-out" letter, offering parents the opportunity to remove their child from participation in the surveys; however, no parents of participants opted out.

SPOTS medical student leaders across all participating institutions were trained in both the SPOTS program and survey administration by the Principal Investigator on this study, to ensure standardization. Data collection was done over 2 consecutive school years, 2022 to 2023 and 2023 to 2024. Most data collection occurred during the months of October to April each academic year. Medical students or participating school officials administered pre-surveys before SPOTS education and then, later, 1-month post-surveys.

Statistical Analysis

Data collected from multiple institutions were compiled and characterized. All surveys were anonymous; therefore, analyses were treated as independent samples of pre-SPOTS versus post-SPOTS surveys. Surveys from 1,508 students were collected pre-SPOTS, and 969 students' post-SPOTS. Descriptive statistics were performed. Chi-square tests were employed to compare participant demographics between pre and post. Survey questions were dichotomized to indicate positive or correct responses. Chi-square tests assessed changes in responses in pre-surveys versus post-surveys, and relative change percentages were calculated. Subgroup analyses were conducted by Fitzpatrick skin types, gender, and geographic region. Breslow–Day tests of homogeneity were used to assess whether changes from pre-SPOTS to post-SPOTS varied by these characteristics. Statistical significance was set at $p < .05$. All statistical analyses were conducted using R Studio (Version 2023) at a 2-tailed alpha = 0.05.

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Results

All Adolescent Participants

A total of 1,508 pre-program surveys and 969 post-program surveys were collected from adolescent participants across Midwestern, Southern, and Western geographic regions of the United States. Adolescent demographics were largely similar across pre-survey and post-survey groups (Table 1). The majority had a Fitzpatrick Skin Type of I to III (pre 76.9% vs post 78.2). A higher proportion of pre-SPOTS survey participants were female compared to post-SPOTS (57.7% vs 50.8%, $p = .001$). In addition, among those completing the post-SPOTS survey compared to pre-SPOTS, there was a greater proportion in middle school (64.0% vs 59.5%, $p = .028$) and those from the Midwest (61.6% vs 51.5%, $p < .001$).

Baseline Sun Exposure Behaviors

To evaluate program impact, the authors assessed participants' sun-exposure and sun-protection behaviors at baseline, before SPOTS education. A majority of participants reported that they never/rarely/sometimes wore sunscreen (58.9%) during the prior summer, and 85% never/rarely/or sometimes wore hats. Moreover, adolescent participants reported having engaged in risky sun-exposure behaviors such as "laying out in the sun for a tan" (33.2%). Similarly, some adolescents utilized other methods to change their natural skin color, including spray tans (4.6%) and self-tanning lotion (13.6%).

Changes in Knowledge

Results showed that students made statistically significant improvements in knowledge of key educational objectives after receiving SPOTS education (Table 2). There was a 34.3% relative improvement ($p < .001$) in the percentage of students who correctly wrote in a recommended sunscreen protection factor (SPF) (minimum of SPF 30). Furthermore, at baseline, 56.6% of students agreed that "Tanning can cause wrinkles or dark spots on my face," which increased to 81.5% post-SPOTS education. This represented a 44% relative improvement ($p < .001$) in adolescents' knowledge that tanning leads to premature aging of the skin. In addition, a statistically significant improvement after SPOTS education was seen, with a 5.9% improvement ($p < .001$) in the percentage of participants agreeing that "Anyone can get skin cancer, regardless of their skin color." There was a high baseline level knowledge of this, with 86.4% of students agreeing with this statement on the pre-survey, compared to 91.5% on the post-survey.

Changes in Attitudes and Beliefs

After SPOTS education, there was a 107.5% relative improvement ($p < .001$) in the percentage of students who believed that a tan is an unhealthy finding. This is attributable to an increase from 26.7% of students on the pre-survey to 55.4% of students on the post-survey who disagreed or strongly disagreed with the statement, "A tan is a sign of healthy skin." Also, the belief that sunscreen is effective in preventing skin cancer improved by 6.6% ($p < .001$). Before SPOTS education, 84.3% agreed that "sunscreen works well to prevent skin cancer," increasing to 89.9% post-program. The one survey question that did not show a significant improvement from pre-SPOTS to post-SPOTS was when students were asked when they feel the most confident, with either their natural skin color versus with any degree of a tan. The majority at baseline, 61.4%, felt most confident with some degree of a tan. This was similar on the post-survey.

Intended Behavior to Wear Sunscreen, Hats, and Avoid Tanning Beds

Students demonstrated statistically significant improvements in all intended sun-protective behavior questions

TABLE 1. Participant Demographics

Variable, *n* (%)	Pre-SPOTS, *N* = 1,508	Post-SPOTS, *N* = 969	*p*
Gender			.001
Male	506 (40.6)	400 (48.4)	
Female	719 (57.7)	420 (50.8)	
Other	21 (1.7)	7 (0.8)	
Grade			.028
Middle school	861 (59.5)	616 (64.0)	
High school	586 (40.5)	346 (36.0)	
Skin type			.475
Type I–III	1,119 (76.9)	756 (78.2)	
Type IV–VI	337 (23.1)	211 (21.8)	
Geographic region			<.001
Midwest	750 (51.5)	595 (61.6)	
South	454 (31.2)	171 (17.7)	
West	252 (17.3)	200 (20.7)	

Each analysis is conducted on nonmissing data for the comparison of interest. *p*-value determined using chi-square test.

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TABLE 2. Pre-SPOTS and Post-SPOTS Participant Attitudes, Knowledge, and Behaviors

Variable, *n* (%)	Pre-survey *N* = 1,508	Post-survey *N* = 969	Relative Change	*p*
Knowledge				
Tanning can cause wrinkles or dark spots on my face				<.001
Strongly agree, agree	815 (56.6)	770 (81.5)	44.00%	
Strongly disagree, disagree, neutral	624 (43.4)	175 (18.5)		
Anyone can get skin cancer, regardless of their skin color				<.001
Strongly agree, agree	1,244 (86.4)	864 (91.5)	5.90%	
Strongly disagree, disagree, neutral	196 (13.6)	80 (8.5)		
What is the minimum sunscreen SPF number that is recommended?				<.001
Correct	802 (59.1)	713 (79.4)	34.30%	
Incorrect	554 (40.9)	185 (20.6)		
Attitudes				
A tan is a sign of healthy skin				<.001
Strongly disagree, disagree	384 (26.7)	523 (55.4)	107.50%	
Strongly agree, agree, neutral	1,055 (73.3)	421 (44.6)		
Sunscreen works well to prevent skin cancer				<.001
Strongly agree, agree	1,211 (84.3)	846 (89.9)	6.60%	
Strongly disagree, disagree, neutral	225 (15.7)	95 (10.1)		
I feel most confident when I have…				.981
My natural skin color	553 (38.6)	363 (38.5)	0.30%	
Dark bronze suntan, light brown suntan, or a little color from the sun	880 (61.4)	581 (61.5)		
Behaviors				
When going outside this summer, how often do you plan to wear sunscreen?				<.001
Most of the time, always	736 (51.3)	616 (65.2)	27.10%	
Never, rarely, sometimes	700 (48.7)	329 (34.8)		
When going outside this coming summer, how often do you plan to wear a hat?				<.001
Most of the time, always	269 (18.7)	268 (28.5)	52.40%	
Never, rarely, sometimes	1,171 (81.3)	674 (71.5)		

Each analysis is conducted on nonmissing data for the comparison of interest. *p*-value determined using chi-square test.

when comparing pre-SPOTS to post-SPOTS education surveys. Regarding sunscreen, there was a 27.1% relative improvement ($p < .001$) in the percentage of participants who selected that they planned to wear sunscreen "Most of the time" or "Always" next summer. Furthermore, there was a 52.4% increase ($p < .001$) in the percentage of participants who selected that they planned to wear a hat "Most of the time" or "Always" after SPOTS education. When asked about tanning beds, 94.4% of adolescent students selected that they would avoid tanning beds because of what they learned in the SPOTS program.

Sunscreen Use Behavior

In addition to intended behaviors, students were also asked about actual sunscreen use after going through the SPOTS program. Post-program data demonstrated that 57.6% of students reported that they had tried to increase their sunscreen use since going through the SPOTS program.

Stratification by Fitzpatrick Skin Type

When stratifying data by Fitzpatrick Skin Type (Types I–III compared with IV–VI), improvement was seen across both subgroups, without statistically significant differences between these demographics. Of note, Fitzpatrick Type IV to VI had a 43% increase in their intended behavior to wear sunscreen always/most of the time during the upcoming summer ($p < .001$).

Stratification by Gender

When stratifying results based on gender, statistically significant differences were noted in relative improvements. Female participants demonstrated a greater relative improvement in their intended behavior to wear sunscreen in the summer in comparison to males (31.6% vs 24.4%, Breslow–Day $p = .04$). Similarly, female participants demonstrated a markedly increased relative improvement when asked how often they planned to wear hats in the

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summer in comparison to males (79.3% vs 12.8%, Breslow–Day $p = .03$); however, this was related to male participants having a higher baseline intention to wear hats in the coming summer (30.6% males vs 10.6% females).

Further, at baseline, female participants were more likely than males to agree that "Tanning can cause wrinkles or dark spots on my face," leading to a greater relative improvement in male participants in this category after SPOTS teaching (92.9% vs 22.0%, Breslow–Day $p < .001$).

Stratification by Geographic Region

Effects were similar across all regions, except for 2 survey items. When prompted with "A tan is a sign of healthy skin" and "Tanning can cause wrinkles or dark spots on my face" statements, all regions showed significant improvements on the post-survey ($p < .001$); however, the Midwestern and Western regions showed a greater degree of improvement in comparison to the Southern region ($p < .001$).

Sharing Sun Protection Outreach With Friends and Family

Notably, in post-SPOTS surveys, nearly half of participants noted that they shared knowledge from the SPOTS presentations with their parents/grandparents/other adults (46.8% of participants) or their friends (43.4% of participants), highlighting the potential for knowledge gained from SPOTS education and outreach to extend beyond student participants and affect other individuals in their personal and social circles.

Discussion

SPOTS is a collaborative, national campaign to educate and empower the youth to protect their skin. The program utilizes health-based and appearance-based motivators to promote sun protection, which may increase effectiveness in adolescents.[22–24] This multi-institutional study evaluating the efficacy of the enhanced SPOTS program demonstrated significant improvements in adolescents' knowledge, attitudes, behaviors, and intended behaviors toward sun protection. Notably, SPOTS was found to statistically improve key outcomes for students with both lighter (Fitzpatrick Types I–III) and darker (Fitzpatrick Types IV–VI) skin colors, across genders, and throughout different geographic regions.

This current multi-institutional study assessing the performance of the SPOTS program builds upon previously published data that showed significant improvements in all teaching objectives.[18] Unlike the prior research, this study utilized an enhanced SPOTS program and evaluated it across a more diverse population in multiple geographic regions. When comparing the 2 studies, the relative improvements in sun protective knowledge, attitudes, and behaviors were mostly greater in this study when compared to the prior.[18]

Skin cancer in individuals with SOC often presents at advanced stages and is associated with poorer prognosis and higher mortality.[28–30] The underlying etiologies for this health disparity are multifactorial. Increasing awareness of the unique presentations of skin cancer on SOC may help address these disparities. The SPOTS program teaches students that skin cancer can present differently on lighter compared to darker skin tones, in both appearance and anatomical location. In addition, the American Academy of Dermatology advises that all individuals should wear sunscreen, regardless of skin color[31–34]; however, studies have found low levels of sunscreen usage in individuals with SOC.[34–36] Therefore, it is noteworthy that after just 1 SPOTS session, students with Fitzpatrick Type IV to VI had a 43% increase in their intended behavior to wear sunscreen always/most of the time during the upcoming summer ($p < .001$). Because statistically significant improvements were identified in both Fitzpatrick skin-type subgroups, SPOTS appears to be impactful with diverse student populations.

Study results revealed some notable differences between genders. At baseline, male participants demonstrated poorer knowledge of tanning outcomes and a lower percentage of intended sunscreen usage than female participants. After SPOTS teaching, male participants demonstrated improvements in these categories highlighting SPOTS as a meaningful program for this at-risk group.

The SPOTS program encourages adolescents to love their natural skin color. Yet the only survey question that did not show an improvement asked students when they feel most confident (i.e., in their natural skin color vs with any degree of a tan). However, in spite of this, there was a significant 107.5% relative improvement in the percentage of students who believed that a tan is unhealthy after SPOTS education ($p < .001$). Moreover, more than half of adolescents (57.6%; $p < .001$) reported behavioral change after SPOTS by having tried to increase their sunscreen use, and 94.4% said they would avoid tanning beds in the future. Still, the difficulty in changing confidence identifies an area for improvement moving forward. It may indicate continued pressure to conform to societal standards of beauty and style,[37] which may permeate the attitudes and beliefs of these students before their middle-school and high-school years. This emphasizes the importance of starting sun protection education and positive self-image messaging at younger ages. To help address this, SPOTS has recently created an entirely new program module designed specifically for elementary age school children, which can be taught by classroom teachers.

The study included 3 geographic regions, but a limitation was not having every geographic region of the United States represented. In the study's planning phase, multiple additional medical schools with active SPOTS chapters in the remaining regions were interested in participating. However, many were deterred from or were unable to participate due to local regulations (Department of Education, public school administration). Furthermore, the study was limited by the 1-month follow-up period for the administration of the post-program survey. Longer follow-up times were initially sought and discussed with participating partner schools; however, they did not find this feasible. These limitations

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highlight the challenges of conducting studies of school-based educational programs. An additional limitation is the differences in gender, geographic region, and grade level between pre-program and post-program survey groups (Table 1), which could have implications on the results. Subgroup stratification analyses were performed to address this limitation.

Conclusion

The data presented here demonstrate the positive impact SPOTS has on an at-risk age group, across Fitzpatrick skin types, genders, and geographic regions. The medical students who teach the adolescent program as a service-learning opportunity also benefit, leading to significant improvements in their confidence to counsel patients and recognize malignant lesions.[18] The inclusion of medical students as teachers has many strengths, as medical students are more relatable yet credible to teens, and they help make the program sustainable. School-based interventions like SPOTS are an important element within a broader, comprehensive skin cancer prevention campaign. To counter the epidemic of skin cancer, it is crucial dermatologists remain at the forefront of promoting skin protective policy changes while leading public health interventions. For more information about SPOTS, please visit www.SpotsEducation.org.

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