

Can Sun Protection Knowledge Change Behavior in a Resistant Population?

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The future skin cancer statistics for the youth of the United States are staggering. Traditional educational programs are currently the mainstay to foster sun protective awareness for this high-risk, sun-worshipping population. This study was designed to monitor high school students for both short-term and long-term changes in knowledge and attitude, as well as for any change in behavior, following a standard sun protection intervention. Our results demonstrated that although students had an increase in knowledge, it was insufficient to change their behavior.

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Skin cancer is the most common type of cancer, accounting for nearly 50% of all cancers diagnosed in the United States.¹ The incidence of melanoma is increasing faster than any other cancer and is now the most frequently occurring cancer in women aged 25 through 29 years.²

Epidemiologic studies have shown that sun exposure is a major environmental risk factor for developing melanoma and nonmelanoma skin cancer.³⁻⁵ Studies also have linked excessive sun exposure during childhood and adolescence to the development of skin cancer in adulthood.⁶⁻⁸ Despite these studies, the social image of looking more attractive with a tan remains embedded in our culture.

Although much progress has been made in the treatment of melanoma, the only way to reduce morbidity and mortality related to this disease is to increase public and professional awareness of the problem and design programs to enhance early

detection and effect behavioral changes.^{9,10} Studies have been conducted in the adolescent population to assess current sun knowledge and behaviors¹¹⁻¹³ and monitor changes in knowledge and intentions following educational programs.¹⁴⁻²⁰ Our study was designed to assess changes in knowledge and intentions, including changes in behavior in the months following an educational intervention. This project had 3 goals: (1) educate high school students on the risks associated with unsafe sun practices; (2) assess changes in knowledge after the presentation; and (3) assess changes in attitude/behavior in the 4 months after the lecture. Results were statistically evaluated to address if traditional education regarding the risks of UV exposure was enough to alter knowledge and behavior.

Methods

This study was approved by the Northeastern Ohio Universities College of Medicine institutional review board. Participants were students from a suburban high school in northeastern Ohio. Exclusion criteria were inability to read, write, or understand English. A 16-question presurvey was administered to determine students' knowledge of UV radiation risks and assess their attitudes about tanning, sun protection, and self-reported sun protection habits. Knowledge questions were based on lecture material for which multiple-choice responses could be given. A Likert scale was used to measure attitude and intentions (never, occasionally, frequently, or always). The survey was modified slightly for use immediately after the lecture and 4 months later. Each student was assigned a number for this project so that presurveys, postsurveys, and follow-up surveys could be analyzed individually.

A standardized educational lecture on proper skin protection and UV radiation damage developed by the RAYS (Raising Awareness About Your Skin) task force²¹ was presented by a fourth-year medical student and time was allowed for questions. The RAYS program consisted of a 45-minute PowerPoint® presentation that examined the risks

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Table 1.

Age, Self-Reported Skin Type, and History of Sunburn in Students

	Males, n (%) (n=244)	Females, n (%) (n=273)
Age, y		
13–14	49 (20)	86 (32)
15–16	172 (71)	150 (55)
≥17	23 (9)	37 (14)
Fitzpatrick skin type		
I	25 (10)	22 (8)
II–III	97 (40)	148 (54)
IV	97 (40)	87 (32)
V–VI	25 (10)	16 (6)
How often did you get sunburned last summer?		
Never	82 (34)	71 (26)
1 or 2 times	136 (56)	157 (58)
≥3 times	26 (10)	45 (16)

of sun exposure and its contribution to skin cancers and premature aging. The presentation also elaborated on effective sun protection, including sun avoidance during peak hours, sunscreen knowledge, and the sun protective effect of clothing. The lectures took place in January and February.

After the lecture, students completed a postsurvey to assess changes in short-term knowledge and attitudes. Four months later (after spring break, prom, and the start of summer), a follow-up survey was administered to determine the long-term changes in knowledge, attitudes, and behaviors.

Students' responses were coded as either correct or incorrect for knowledge questions. Students' selections over time (presurvey, postsurvey, and 4 months later) were analyzed with a repeat measures test for nonparametric data (Friedman test). Long-term retention of knowledge was examined with a nonparametric test for correlated samples (Wilcoxon signed rank test) to determine if significantly more students answered questions correctly 4 months after the lecture versus before the lecture.

Self-reported attitudes, intentions, and behavior from the prelecture survey and data collected 4 months after the lecture were analyzed with the Wilcoxon signed rank test to determine the long-term effect of the lecture on these parameters.

Baseline responses between genders were analyzed with the Mann-Whitney test. Male and female students were then analyzed separately over time when there were baseline differences between the genders but were analyzed together if there were no baseline differences between the 2 groups. Because of the number of statistical tests conducted, results were significant when $P < .01$. SPSS® for Windows® (version 11.5) was used for analysis.

Results

Demographics—There were 2 new students from a non-English-speaking country with marginal ability to read English. Their data were not included in the analysis. Eighty-eight percent of the students who listened to the initial lecture completed all 3 surveys (517 students of the initial 589 students enrolled).

Table 2.

Percentage of Students Who Answered Knowledge Questions Correctly Before, Immediately After, and 4 Months After the Lecture (N=517)*

Correct Answers to Knowledge Questions	Baseline, %	Immediately After Lecture, %	4 Mo After Lecture, % [†]	χ^2 [‡]
Sun damages your skin every time you get a tan	54	82	73 [§]	95.4**
Tanning beds damage your skin every time you get a tan	70	93	82	88.7**
Yes, you can get a tan with a sunscreen	89	96	92	20.0**
Peak hours for sun damage are 10 AM to 4 PM	52	97	62	9.2 ^{††}
Melanoma is not characterized by a crusty top	23	58	26	13.7 ^{‡‡}
65%–90% of melanomas are caused by UV exposure	41	69	45	77.6**
Melanoma can be prevented with a hat, clothing, sunglasses, avoiding tanning beds	75	91	81	55.5**
Daily sunscreen with SPF \geq 4 should be used	24	78	38 [#]	259.6**

*SPF indicates sun protection factor.

[†]Wilcoxon signed rank test of baseline vs 4 mo postlecture.

[‡]Friedman test of responses at baseline, immediately after, and 4 mo postlecture.

[§] $z = -7.124$, $P < .001$.

^{||} $z = -5.157$, $P < .001$.

[†] $z = -3.315$, $P = .001$.

[#] $z = -5.131$, $P < .001$.

** $P < .001$.

^{††} $P = .01$.

^{‡‡} $P = .001$.

Forty-seven percent of students were males (244/517). The average student age was 15 to 16 years, and Fitzpatrick skin types II to III were reported most often (Table 1). Seventy percent of the students reported that they had at least 1 sunburn last summer and 14% of students claimed they had 3 or more sunburns.

Knowledge—Gender differences were demonstrated in only one baseline knowledge question—more female students were aware that tanning beds caused skin damage than male students ($z = -3.256$, $P = .001$). Changes in selection of the correct response by male and female students over time were therefore analyzed together.

The percentage of correct responses to the knowledge questions ranged from 23% to 89% before the lecture (Table 2). For 5 of 8 knowledge questions, less than 60% of students responded correctly. The number of students who answered

correctly increased over time. Immediately after the RAYS lecture, only one question had a correct response rate below 60%. Four months later, correct responses to all of the knowledge questions decreased compared with responses immediately after the lecture. Four questions were answered correctly significantly more frequently 4 months after the lecture. For example, 228 students answered the question about sun damage correctly before the lecture as well as 4 months later; 88 students answered the question incorrectly both times; 50 students answered the question correctly the first time but incorrectly 4 months later; and 151 students answered the question incorrectly the first time and correctly 4 months later. Correct responses to 4 of the knowledge questions remained below 65% at 4 months after the lecture.

Table 3.

Response to Questions at Baseline and 4 Months After the Lecture

Question	Baseline Males, % (n=244)	Baseline Females, % (n=273)	4-Mo Follow-up Males, %	4-Mo Follow-up Females, %	z Score
How often do you use sunscreen (have you used sunscreen in past 4 mo)?					
Never	29.9	12.8	73.0	56.4	-4.517**†
Occasionally	48.4	54.6	21.3	31.9	-8.452†‡
Frequently	17.6	26.0	3.7	8.4	-9.913†§
Always	4.1	6.6	2.0	3.3	
When do you use sunscreen (when will you use sunscreen)?					
I won't use sunscreen	30.7	15.4	24.2	13.6	-4.032**†
When in sun for activity	62.7	74.7	61.9	62.6	-3.662†‡
When outside for any reason	6.1	9.2	10.7	20.9	-4.695†§
Every day	0.4	0.7	3.3	2.9	
How often will you use a hat or other protective clothing when you are out in the sun?					
Never	17.2	34.8	12.7	26.0	-7.696**†
Occasionally	41.8	54.6	41.8	55.3	-1.333‡
Frequently	25.8	8.8	30.7	14.7	-4.0†§
Always	15.2	1.8	14.8	4.0	
How important is a tan to you?					
Not at all important	35.7	12.1	36.1	15.0	-7.812**†
A little important	31.6	22.7	25.0	24.5	-1.749‡
Moderately important	22.1	38.1	26.6	29.3	-0.141§
Important	7.4	20.1	7.0	21.6	
Very important	3.3	7.0	5.3	9.5	

Question	Baseline Males, % (n=244)	Baseline Females, % (n=273)	4-Mo Follow-up Males, %	4-Mo Follow-up Females, %	z Score
What kind of a tan do you try to obtain (how tan do you think you will get this summer)?					
I won't get a tan	38.9	12.8	12.7	8.8	-7.262**†
A light tan	27.5	26.4	27.0	23.8	-9.174†‡
A moderate tan	30.3	52.0	33.2	46.5	-4.423†§
A dark tan	3.3	8.8	27.0	20.9	
How often do you use a tanning bed (have you used a tanning bed in the past 4 mo)?					
Never	95.5	65.9	93.0	65.2	-8.257**†
Just for special occasions	3.3	31.5	3.7	23.4	-1.9‡
>20×/y (follow-up: >15×/y)	1.2	2.6	3.3	11.4	-2.877§

*Baseline gender difference.
†P<.001.
‡Follow-up vs baseline, males.
§Follow-up vs baseline, females.
||P=.004.

Attitudes/Intentions/Behaviors—Gender differences in the attitudes and behaviors of this adolescent group were observed at baseline (Table 3). Male students used less sunscreen than female students, with approximately 30% of male students stating that they never use sunscreens compared with approximately 13% of female students. However, the male students did use more sun protective clothing such as hats (approximately 41% answered frequently or always). Approximately 35% of female students reported never wearing sun protective clothing compared with approximately 17% of male students.

The reasons for not using sunscreen were not significantly different between groups ($z=-2.205$,

$P=.027$, data not shown). The female students reported not using sunscreen because they wanted a tan (37%) or forgot to put it on (37%), while the male students reported they did not need the sunscreen (28%), it was too much trouble (24%), or forgot to put it on (37%).

Attitude differences at baseline were strongly noted in the importance of a tan. Approximately 65% of female students claimed that it was moderately important, important, or very important to get a tan compared with approximately 33% of male students. Additionally, female students reported trying to obtain a darker tan than male students. Fifty-two percent of female students reported they

wanted to obtain a moderate tan, while approximately 39% of male students reported they would not get a tan. Strong gender differences also were noted in the baseline attitude toward tanning bed use. Female students were more likely to use tanning beds, with approximately 32% of female students using tanning beds for special occasions compared with approximately 3% of male students.

Four months after the lecture, there was a noticeable change in the percentage of female students who reported that they would use sun protective clothing. There was a decrease in the number of female students who reported they would never wear sun protective clothing and an increase in the percentage who reported they would frequently or always wear sun protective clothing. There also was a change in the reported intention to use sunscreen; there was an increase in the percentage of both male and female students who reported they intended to use sunscreen when outside for any reason and a decrease in the percentage of both male and female students who reported they would not use sunscreen. There was no significant change in the reported importance of tanning. The 4-month follow-up data demonstrated a large increase in the percentage of male and female students who claimed they never used sunscreen in the past 4 months relative to their reported use at baseline. There also was an increase in the percentage of male and female students who reported they would get a dark tan. Four months after the lecture, more male and female students reported that they would get a dark tan (27% vs 3% and 21% vs 9%, respectively). There also was an increase in the percentage of female students who reported using a tanning bed more than 20 times per year compared with baseline (11% vs 3%).

Comment

This study was designed to monitor both short-term and long-term changes in knowledge and attitude, as well as behavior, following a standard sun protection intervention. The results of this study were similar to those reported elsewhere, suggesting that adolescents do not practice “safe sun.”^{11-14,18-20} Despite the awareness that excessive sun exposure can cause skin cancer, the students’ high-risk sun practices actually increased after the intervention, with fewer students claiming to have used sunscreen, more female students reporting use of tanning beds, and both male and female students reporting they would get a dark tan over the summer.

It is apparent that in this population, risk perception does not always inhibit risk behavior. Other studies also have shown that adolescents are aware

that sun exposure can lead to skin cancer, but this knowledge appears to have little relationship to the adoption of sun protective behaviors.^{13,18,20,22} A study conducted of teenagers in Texas reported that the majority of teenagers 16 years or older believed that a suntan enhanced their appearance and was more important to them than the potential risk for melanoma.¹⁴ This attitude impedes teaching the importance of sun protection.

Although our study demonstrated significant increases in knowledge immediately after the lecture, the 4-month postsurvey demonstrated that the students’ knowledge level had decreased toward baseline levels, suggesting that the traditional classroom intervention with only a single exposure to the data was not enough to solidify long-term knowledge. This phenomenon has been reported by others.¹⁶⁻²⁰

The gender differences seen in our study were similar to those reported in other studies, with females using more sunscreen and being the biggest abusers of tanning beds.^{11,13,23} We also demonstrated a gender difference regarding the importance of a tan: female students found a tan moderately to very important, while male students were more likely to claim that a tan was not important. In addition, female students claimed they did not use sunscreen because they wanted to get a tan, and male students simply did not feel the need to use sunscreen.

One of the greatest barriers we have to attaining safe sun practice in this high-risk population is the attitude that people look better with a tan. The myth that tanning is healthful began in the 1920s with the discovery of the sun’s role in vitamin D synthesis. Despite years of trying to modify public opinion, the favorable attitude toward tanning persists.²⁴ A 1996 telephone survey of 1000 adults conducted by the American Academy of Dermatology showed that 56% of respondents believed that persons looked healthy with a tan and 25% claimed they intentionally worked on a tan.²⁵ Tanning behaviors will not change until our social images change.²⁶ An encouraging study from the Department of Psychology at the University of California reported greater protective behaviors and less sunbathing in college students when an appearance-based intervention was used including UV photos and photoaging knowledge.²⁷

Limitations—Several limitations exist within this study. A one-time intervention was done in January and February with the follow-up survey given in June before the end of the school year. This time period was chosen to provide continuity with the students in that school year. Although the summer months were not included following the intervention, this period

did cover spring break and prom; a follow-up in September might have better assessed the students' actual use of sun precautions, giving them more opportunities to follow through on their intention to use sunscreens. Additional studies should be done with repeated interventions and over a varied seasonal time frame to assess whether a change in outcomes could be effected.

Another limitation was that the students were all from northeastern Ohio; however, our findings were consistent with those of other regional studies done throughout the United States.¹¹⁻¹⁵

The standardized lecture material used to educate this high-risk population also is a variable in this study. Similar school-based intervention studies from suburban Chicago, Illinois, and Stockholm, Sweden, also have demonstrated an increase in knowledge but no change in behavior following the intervention.¹⁸⁻²⁰ It is possible, however, that other educational programs or teaching devices might result in different outcomes. In a recent study by Mahler et al,²⁸ UV photographs were taken of a subset of subjects following an educational intervention. As a result, stronger sun protection intentions and behaviors were practiced by subjects whose UV photos were taken.²⁸

This study, along with those previously reported, suggest that an adolescent educational model alone is not enough to change the poor behavioral decisions teenagers are making with regard to skin protection.^{10,13,18-20} Perhaps if the educational intervention were started earlier in life and reinforced more often, we could obtain better attitudes and behaviors during these high-risk teenaged years.^{27,29}

The current and future skin cancer statistics are staggering. A new approach is needed to halt the rising skin cancer predictions for the youth of America. Other studies have suggested mass media campaigns to better target this high-risk population.^{15,18,26,30} Perhaps a mass media program similar to the "Take a Stand" campaign, which targets against tobacco use in teenagers, could be developed to convey our message. Teenagers might be more receptive to receiving this information from peers and celebrities.

A change in teenagers' attitudes and behaviors with regard to the dangers of the sun would have an immense impact on morbidity and mortality associated with skin cancer and could lower the economic and financial strain on its diagnosis and cure.

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