



College Students' Knowledge, Attitudes and Perceptions of Risks Regarding Intentional Sun Exposure: A 17-Year Follow-Up

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ABSTRACT

Background: Skin cancer, the most common cancer in the United States, accounts for over one million cases per year. Risk can be mediated by limiting UV radiation exposure, yet efforts to increase adoption of protective measures have met with limited success. **Purpose:** This study compares the results of surveys conducted in 1990 and 2007 assessing the knowledge, attitudes and behaviors of college students regarding intentional sun exposure. **Methods:** The 44-item "Sun and Skin Inventory" was administered to students enrolled in personal health classes during the fall semesters in 1990 and 2007. **Results:** Mean knowledge scores were no different in 2007 than 1990 and knowledge scores were not related to sunbathing frequency in either survey. Risk perception was negatively related to sunbathing frequency and students reporting greater perceived risk had more positive attitudes toward protective behaviors. Overall, sunbathing behavior was unchanged over 17 years, but students did report more frequent sunscreen use in the latter survey. **Discussion:** Despite educational efforts regarding risks related to intentional UV exposure, high risk behavior continues among adults. **Translation to Health Education Practice:** Comprehensive prevention initiatives that include education as well as policy and environmental strategies integrated across state, regional and local levels need to be implemented.

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BACKGROUND

Each year, more than one million non-melanoma skin cancer cases are diagnosed in the United States.¹ Skin cancer is the most common of all cancers in the United States and accounts for nearly half of all cancers diagnosed.¹ Nearly 69,000 skin cancer cases diagnosed in 2009 will be melanoma, the most serious form of skin cancer. Melanoma is currently the second most common cancer among 20- to 29-year-old women.² Most skin cancer deaths are from melanoma, which is among the most rapidly rising cancers in the U.S.^{1,2} Melanoma incidence rates increased an average of

2.7% per year in the U.S. from 1992 through 1998.³ According to the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) cancer registry, the age-adjusted incidence rate of melanoma between 2002-2006 was 25.0 per 100,000 men and 15.8 per 100,000 for women. It is estimated that close to 9,000 people will die of melanoma in 2009 alone.⁴

Controllable risk factors for non-melanoma and melanoma skin cancers include: unprotected and/or excessive exposure to ultraviolet (UV) radiation (including intentional exposure to the sun such as getting a tan or sunbathing, intentional exposure to

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UV radiation with sunlamps or tanning beds, or environmental exposure such as where one lives, season and altitude), occupational exposures to coal tar, pitch, creosote, arsenic compounds, or radium and severe childhood sunburns.^{1,2} Uncontrollable risk factors include fair complexion, family history and multiple or atypical moles.¹ Most skin cancer cases are preventable by following sun-protective behaviors, however, approximately 50% of the adults in the U.S. do not practice preventive measures.⁵ Tanning booth usage tripled from 1986–1996.⁶ Using tanning beds is more common among women, particularly young women, who perceive that a tan gives the appearance of looking healthy and attractive to others.¹ Gerrard et al.⁷ and Demko et al.⁸ found that more than one-half of female students and 15% of male students at a Midwestern college reported recent usage of tanning salons with some students reporting up to as many as 50 visits per year.

For most, a skin tan provides an immediate reward and skin cancer risk seems less likely or more of a distant health issue, which leads to low perceived risk and less motivation to protect oneself.⁹ Those who perceive themselves to be at risk tend to be those who have known someone who has been diagnosed with skin cancer.⁹ Those that do engage in skin cancer prevention behaviors tend to be women and those who use sunscreen as the preventive method of choice.¹⁰

According to the ACS¹, the best way to lower the risk of non-melanoma skin cancer is to avoid exposure to intense sunlight for long periods of time by practicing sun safety, which includes avoiding the sun between 10:00 a.m. – 4:00 p.m., wearing protective clothing while in the sun, using sunscreen and lip balm with a sun protective factor (SPF) of 15 or higher, and avoiding other sources of UV (ultraviolet) light, such as tanning beds and sun lamps. Evidence suggests that the increase in skin cancer over the last 30 years is due to high-risk behaviors increasing exposure to solar UV radiation.^{1,2,5}

The effects of UV radiation are cumula-

tive.¹ The immediate effects are sunburn, possible eye damage and suppression of the immune system. Long-term effects include premature aging of the skin, wrinkles and skin cancer.^{1,2, 11,12} An ACS study conducted in 2004 found that more than two-thirds of youth reported getting sunburned during the summer, that sunburn rates were higher in youths whose skin does not tan as easily and is more prone to burning (84.5%), and that most of the tanners were female (71.5%).¹ The Behavioral Risk Factor Surveillance System¹³ reported that 41.2% of white adults and 21% of Hispanics aged 18 and over were sunburned in the past year. African American adults had the lowest rate of sunburns (5.7%). Adults aged 18–29 years had the highest reporting of sunburns with 64% of the sample reporting having had sunburn in the past year.

A recent study by Hornung and Poor-sattar¹⁴ found that of 385 male and female college students surveyed, 18 percent of outdoor sunbathers and 28 percent of indoor tanning bed users scored positively on instrumentation reflecting a substance-related disorder (SRD), suggesting a possible addiction to tanning among college students. The researchers noted that traditional health education messages are not effective with a sun addictive population. As with other addictive behavior, greater intervention and behavior modification to change the high-risk behavior is required. Forty-one percent of the frequent tanners disclosed that they tanned to relax, which is also a common reason people engage in drug and alcohol use.¹⁴

Little improvement in sun protection practices has been achieved among adults and youth in recent decades, despite educational efforts to inform the public of the harmful effects from excessive and intentional sun exposure. Data suggest that despite increased awareness of the harmful effects of repeated sun exposure, high-risk behavior continues among adolescents and young adults, which presents a continual challenge for health educators.^{15–18} Despite targeted initiatives and strategies to increase knowledge levels of the harmful effects of

intentional sun exposure young adults do not seem to be altering their tanning behavior.^{6,11,15–24} One unique approach that may deter one's desire to tan has been the use of UV photography in increasing awareness of future skin damage. Gerrard et al.^{7,25} found that using UV photography with actual images of the participant with future sun damage imposed on their own picture may serve as a deterrent for college students' use of tanning booths and intentional outdoor tanning. Myers and Horswill²⁶ found that self-efficacy and perceived control over one's sun exposure was a greater predictor of sun protection intention and behavior than perceived control and reiterated the importance of increasing feelings of self-efficacy for sun exposure protection when targeting sun protection behaviors. A number of health education prevention efforts have been implemented that have shown some increase in health knowledge; however, actual behavior change has been minimal and the majority of U.S. young adults continue to engage in high levels of sun exposure with limited protection.^{6,9,12–17}

Since our original study in 1990, national skin cancer prevention campaigns have been targeted to the general population and college-aged young adults that may have impacted the knowledge of the general population, including our 2007 respondents, regarding the harmful effects of sun exposure. It should be noted that the researchers were unable to locate information on the effectiveness of these programs and the authors are not suggesting these campaigns directly impact student's behavior or practices but may influence their awareness of sun prevention guidelines. Some examples of large, national, sun prevention campaigns include the CDC's "Choose Your Cover" campaign²⁴ and the American Academy of Dermatology's "Be Sun Smart," which focuses on the importance of protection while enjoying outdoor activities and provides easy to implement skin cancer prevention strategies.²⁷ The Weather Channel has a national awareness initiative called "Rays Awareness." The purpose of the campaign is to not only educate individuals on the dan-



gers of sun overexposure, but also to assist them in developing ways to enjoy outdoor activities.²⁸ The Women's Dermatologic Society's Community Outreach supports sun safety through a broad-based national campaign known as "Families Play Safe in the Sun." The campaign offers free skin cancer screenings, education materials, and sun protection activities.²⁹ The Sun Safety Alliance is a nonprofit agency that is committed to decreasing the occurrence of skin cancer in America by encouraging individuals to engage in skin cancer prevention behaviors. Through increasing awareness and motivation, assisting health care professionals in education techniques, and generating sun-safety standards, the Sun Safety Alliance's goal is to make a considerable difference in the prevalence of skin cancer across the United States.³⁰ The SHADE Foundation of America serves to eliminate melanoma by means of education in prevention and detection of skin cancer, as well as advocating sun safety. The Foundation offers interactive advocacy opportunities.³¹ In addition to national prevention campaigns, dermatologists have also included more messaging and preventive efforts with their patients and many campus wellness programs have incorporated sun-safety education and outreach programs in their initiatives.^{6,9,10,31}

Healthy People 2010 aims to reduce high-risk behaviors related to sun exposure and reduce deaths from melanoma. Objective 3-9 aims to increase the proportion of persons who use at least one of the following protective measures that may reduce the risk of skin cancer: avoid the sun between 10:00 a.m. and 4:00 p.m., wear sun protective clothing when exposed to sunlight, use sunscreen with a sun-protection factor (SPF) of 15 or higher, and avoid artificial sources of ultraviolet light by 75% of adults aged 18 or over. Objective 3-8 is to reduce melanoma deaths to 2.5 per 100,000 persons.³² Effective and continued assessment and multifaceted community-based interventions are imperative to further efforts to reduce high-risk behaviors associated with intentional tanning among young adults.^{33,34}

PURPOSE

The purpose of this study was to assess the knowledge, attitudes and behaviors of college students regarding intentional sun exposure and to compare those findings with a similar study conducted in 1990, seventeen years earlier. Since the original study, a number of local and national, formal and informal educational campaigns have been conducted by various organizations attempting to raise awareness of the dangers of and to curb intentional sun exposure. Our study sheds light on the effectiveness of these campaigns in the college student population and may provide guidance for improving future prevention efforts.

METHODS

Instrumentation

The survey instrument utilized in this study included five demographic items and the 44-item "Sun and Skin Inventory."³⁵ The "Sun and Skin Inventory" includes: a knowledge scale, skin cancer risk assessment items and an attitude scale and items pertaining to sunbathing and sunscreen use behavior. The knowledge scale included 12 items assessing intentional sun exposure and skin protection. These items primarily pertained to the efficacy of skin protection strategies and the pathological outcomes of sun exposure. Self-perceived skin cancer risk items included those assessing complexion, tendency to sunburn, relative number of nevi and family history. The 10-question attitude scale included items measuring attitudes toward the: (1) desirability of tanned skin, (2) potential long-term negative effects of intentional sun exposure, and (3) utilization of sunscreens.

In the original validation,³⁵ Pearson product-moment correlations were computed to investigate the inter-item correlation structure of the attitude scale. Item-total correlations ranged from .64 ("I'm not worried about the possibility of sun exposure causing my skin to age prematurely.") to .43 ("I look thinner with a suntan." and "Sunscreens are too messy to use on a regular basis."). All item-total correlations had *P* values < 0.01. The mean item-total correlation was

.52. To evaluate inter-item consistency each item on the scale was correlated with every other item. The reliability coefficient of the attitude scale was .70 by Cronbach's α and .72 by split-half methods corrected by the Spearman-Brown formula.

Sample and Administration

Participants for this study were enrolled in a personal health course required of all students attending a large southeastern university during the fall semesters of 1990 and 2007. Participation was voluntary and anonymous. In 1990, we randomly selected 10 of the 47 class sections for survey administration. Survey administration in 1990 was conducted in-class using traditional "pencil and paper" methods. Questionnaires were completed by 341 of the possible 380 students enrolled in the randomly selected sections (89.7%) with 296 Caucasian students included in the data set that was analyzed. The sample was comprised of 180 women (60.8%) and 116 men (39.2%). Whereas most students were 18 years of age (178, 60.3%), 19 (6.4%) were 17, 61 (20.7%) were 19, 19 (6.4%) were 20, and 18 (6.1%) were 21 and older.

In 2007, after approval of the research project by the university Institutional Review Board, the questionnaire was administered to students enrolled in the same required personal health course that was utilized in the 1990 study. It was administered using a database-connected web form constructed by the research team using Microsoft Active Server Page (ASP). All students enrolled in every section of Health 1000 were invited to participate in the study. An invitation to participate and the survey access link was emailed to every student and posted on the BlackBoard 'Announcements' page for every Health 1000 section. The invitation informed students that participation was voluntary and anonymous. The Internet survey protocol randomly directed half of the respondents to this questionnaire and the other half to another non-related research study. Consequently, of the 2198 students enrolled in Health 1000, half (1099) could have potentially participated in our study. Of these, 819 completed this survey, result-



ing in a 74.5% response rate. Participants received extra credit for taking the survey by presenting their Health 1000 instructor a “receipt” that was produced when responses were submitted.

The results for the 2007 were based on the 596 Caucasian respondents. The sample was comprised of 375 women (63.1%) and 219 men (36.9%). Because the survey was conducted in a freshman level class, most of the respondents were 18 (301, 52.5%), 19 (161, 28.1%) or 20 (48, 8.4%). The remainder were 21 and over (53, 9.3%) or 17 years old (10, 1.7%).

Studying college students from the southern U.S. about intentional sun exposure behavior is appropriate for several reasons. First, the incidence of skin cancer in Caucasians generally increases with proximity to the equator.³⁶ Second, those between 18-29 years of age are more likely to report higher incidence of sun exposure and more frequent sunburns. This age group is also less likely to use sunscreens.³⁷ Also, compared to most adults, college students have more discretionary time during daylight hours that could potentially be spent in the sun. Consequently, compared with the general adult population, college students in the south could be considered more at risk for developing skin cancer than other adults.

Statistical Analysis

Scale scores were calculated for knowledge, attitudes, and self-perceived risk factors. Independent samples *t*-tests were used to compare mean knowledge scores from 1990 and 2007 and to analyze the difference in attitudes scores between frequent and less frequent sunbathers. Pearson correlation coefficients were used to describe the relationship between knowledge and sunbathing frequency and attitudes, and between self-perceived risk factors and sunbathing frequency and attitudes. Responses from 1990 and 2007 were compared using chi-square tests of independence, as were gender differences for some questions.

RESULTS

For both the 1990 (mean [SD], 9.34 [1.76]) and 2007 (mean [SD], 9.46 [1.82])

the scores on the 12-item knowledge scale were relatively high and not significantly different ($t_{1,295} = .095$, *ns*). The most frequently missed items included: (1) “moisturizers can repair sun damage” (35.6%), (2) “if you avoid the sun between 10 a.m. and 2 p.m. you can get a dark tan safely” (24.7%), and (3) “if you are not usually exposed to the sun being severely sunburned two or three times during your life will probably not increase your chances of skin disease” (26.2%). These were the same items that were most commonly missed in 1990. In addition, 41% in the 2007 survey believed that gradual tanning eliminates most of the negative effects of lengthy exposure to the sun. As in the prior survey, women scored significantly higher (mean = 9.71) on the knowledge scale than did men (mean = 9.04), ($t_{1,589} = 4.42$, $P < 0.001$).

In 2007, knowledge scores and frequency of sunbathing were unrelated ($r = .072$, *ns*). Those students who reported having used a tanning salon had higher mean knowledge scores (mean [SD], 9.62 [1.79]) than those who had not used a tanning salon (mean [SD], 9.26 [1.82]), ($t_{1,589} = 2.38$, $P < 0.05$). A higher knowledge score was positively correlated with a more healthful attitude about sunbathing ($r = .243$, $P < 0.001$).

There was a significant negative correlation between the number of self-perceived risk factors (higher score equated to greater self-perceived risk) and the frequency of sunbathing ($r = -.184$, $P < 0.001$). Those with greater self-assessed risk also reported a more healthful attitude about sun exposure ($r = -.216$, $P < 0.001$) and increased sunscreen use ($r = .305$, $P < 0.001$). Those reporting a lower frequency of sunbathing behavior were more likely to use sunscreens ($r = .191$, $P < 0.01$).

Students with more healthful attitudes about sunbathing sunbathed less often ($r = .398$, $P < 0.01$) while those reporting that they “look better with a tan” reported a higher frequency of sunbathing ($r = .336$, $P < 0.001$). All of these findings were consistent with the 1990 data.

Table 1 shows responses to items assessing attitudes toward tanning and skin

protection in 1990 and 2007. Respondents to the 2007 survey generally reported less favorable attitudes toward tanned skin. Compared to 1990 respondents fewer 2007 respondents agreed that: (1) they looked better with a suntan ($\chi^2 = 20.99$, $P < 0.05$), (2) suntanned skin looked more attractive ($\chi^2 = 19.68$, $P < 0.05$), and (3) suntans look healthy ($\chi^2 = 20.25$, $P < 0.05$). Despite reporting less positive attitudes toward tanned skin, more 2007 respondents stated that they enjoyed sunbathing than did respondents in 1990 ($\chi^2 = 21.08$, $P < 0.05$).

Concerns about the potential negative effects of tanning centered on skin cancer risk with a greater proportion of 2007 respondents disagreeing with the statement that, “I am not worried about getting skin cancer” ($\chi^2 = 16.46$, $P < 0.05$). There was less concern regarding general sun-related skin damage (“I’m not worried about the possibility of sun exposure causing my skin to age prematurely,” “It’s important for me to have a tan now, I’ll worry about wrinkles resulting from sun damage later”) and these concerns did not appear to change over the period between the two surveys.

Relative to sunscreen use fewer than 20% of respondents in both surveys felt that “sunscreen was too messy to use” with no significant difference between the two survey groups. However, the proportion of students agreeing that sunscreen was “too expensive to use” did decline from 1990 to 2007 ($\chi^2 = 21.79$, $P < 0.05$).

The frequency and circumstances of using sunscreen changed from 1990 to 2007 ($\chi^2 = 62.68$, $P < 0.001$). In 1990, half (50%) of the respondents reported that they rarely, if ever, used sunscreen; in 2007 just 27% reported that they rarely, if ever, used sunscreen. The percentage of respondents who reported using sunscreen with at least SPF 15 when they would be exposed to the sun for at least one half hour increased from 9% in 1990 to 22% in 2007 (Table 2).

We asked respondents to report on risk factors for skin cancer (Table 3). Women appeared somewhat more likely to classify themselves in the categories of greatest of risk; however, this trend only reached sig-



Table 1. Comparison of Frequency of Responses to Items Assessing Attitudes toward Tanning and Skin Protection: 1990 and 2007^a

Category/response ^b	Year of survey	SD %	D %	N %	A %	SA %	χ^2
Desirability of tanned skin/tanning							
I look better with a suntan	1990	1.7	1.7	6.4	41.4	48.8	20.99**
	2007	3.5	3.2	10.4	49.0	33.8	
I enjoy sunbathing	1990	7.1	24.7	17.6	34.8	15.5	21.08**
	2007	7.6	12.6	20.1	40.1	19.6	
Suntans look healthy	1990	0.7	6.4	28.6	52.2	12.1	20.25**
	2007	1.8	7.6	40.2	44.0	6.4	
I look thinner with a suntan	1990	10.2	20.7	44.7	18.0	6.4	7.93
	2007	7.1	20.5	40.1	25.1	7.2	
Suntanned skin is more attractive than skin that is not tanned	1990	3.0	8.1	15.5	42.1	31.3	19.68**
	2007	1.7	8.8	22.3	47.7	19.5	
Concern with negative effects of sun exposure							
I'm not worried about getting skin cancer	1990	21.0	36.3	23.4	16.6	2.7	16.46**
	2007	11.6	43.4	26.4	17.0	1.5	
I'm not worried about the possibility of sun exposure causing my skin to age prematurely	1990	23.0	40.2	18.6	16.9	1.4	5.22
	2007	17.9	42.5	23.1	15.0	1.5	
It's important for me to have a tan now, I'll worry about wrinkles resulting from sun damage later	1990	16.2	32.7	36.0	14.5	0.7	4.15
	2007	13.0	35.7	32.8	17.1	1.4	
Utilization of sunscreens							
Sunscreens are too messy to use on a regular basis	1990	21.5	39.7	20.2	18.2	0.3	6.27
	2007	18.5	42.4	19.7	17.1	2.4	
Sunscreens are too expensive to use on a regular basis	1990	24.0	41.9	22.6	9.1	2.4	21.79**
	2007	32.0	48.0	13.5	5.2	1.3	

** P < .01.

Notes: ^aFor the 1990 sample n = 296 and for the 2007 n = 596

^bReponse Categories: SD=Strongly Disagree, D=Disagree, U=undecided, A=Agree, SA=Strongly Agree

nificance for family history, with 41.8% of women reporting a family history for skin cancer compared to 30.7% of men ($\chi^2 = 7.20$, $P < 0.01$). A similar finding occurred in the 1990. It is important to note that percentage of total respondents reporting family histories for skin cancers increased from 25.3% in 1990 to 37.7% in 2007.

Respondents were asked “During the past summer how often did you sunbathe (‘lay

out?’)” Table 4 shows that in both the 1990 and 2007 samples more than 60% of the respondents reported sunbathing at least one time per week. There were no differences in sunbathing behavior noted between the two sets of respondents ($\chi^2 = 1.98$, *ns*).

Table 5 displays the mean attitude scores of the 2007 respondents as a function of frequency of sunbathing. The table also states whether or not the 2007 findings were

consistent with our former study. Generally, the desirability of tanned skin was associated with a higher frequency of sunbathing. For all but one survey item (“I look thinner with a suntan”) these findings were consistent with the earlier survey. The only other attitude item that was associated with sunbathing behavior was the item that stated “It is important for me to have a tan now, I’ll worry about wrinkles resulting from sun



Table 2. Comparison of Percentage of Positive Responses to Items Assessing Reported Frequency/Circumstances of Using Sunscreen: 1990 and 2007

Category/response	Percentage of respondents ^a	
	1990 (N = 252)	2007 (N = 591)
I use sunscreen with at least SPF 15 whenever I know I will be exposed to the sun for at least one half hour.	9.1	22.0
I use sunscreen with at least SPF 15 when I go to the beach or sunbathe but rarely at any other time.	17.1	33.2
I use sunscreens with at least an SPF of 15 when I'm sunbathing or at the beach early in the summer but, as I tan, either stop using them or choose a lotion with a lower SPF number.	23.4	17.4
I rarely if ever use sunscreens.	50.0	27.4

^a $\chi^2 = 62.68, df=3, P < 0.001$

Table 3. Comparison of Percentage of 2007 Respondents by Gender Choosing Response Indicating Greatest Risk for Skin Cancer Development

Risk factor/Survey item	Total (N = 596) %	Women (N = 375) %	Men (N = 219) %	χ^2
Complexion: Very light, I am fair skinned	7.6	9.9	3.7	8.12 (df = 4)
Tendency to sunburn: Much more likely to sunburn	18.1	19.5	15.6	1.46 (df = 2)
Number of moles: More moles than most	9.9	10.4	9.2	0.97 (df = 2)
Sunburn frequency: 3 or more sunburns per summer	13.8	13.9	13.7	3.02 (df = 3)
Family history: Someone in my family has been diagnosed with skin cancer	37.7	41.8	30.7	7.20* (df=1)

* $P < 0.05$

damage later.” Whereas we classified the item as having to do with concern with negative effects of sun exposure, it also is associated with the desirability of tan skin.

DISCUSSION

In this 17-year follow-up study, knowledge, attitudes and behaviors of a similar sample of college freshman students regarding intentional sun exposure were assessed to determine if any shifts in these variables had

occurred since the first study was conducted. Further, this study sought to examine whether the increase in skin cancer prevention campaigns and awareness programs has impacted college student’s knowledge, attitudes and behaviors with respect to sun exposure risk and prevention. Though direct causation cannot be measured, our findings suggest that campus wellness initiatives, local and national skin cancer prevention programs may not be effective in changing

students’ knowledge, since the mean scores for knowledge were not significantly higher 17 years later. In both 1990 and 2007, the most frequently missed items included: (1) “moisturizers can repair sun damage,” (2) “if you avoid the sun between 10:00 a.m. and 2:00 p.m., you can get a dark tan safely,” and (3) “if you are not usually exposed to the sun, being severely sunburned two or three times during your life will probably not increase your chances of skin disease.” Both studies

**Table 4. Comparison of Sunbathing Frequency in College Student Sample: 1990 and 2007^a**

Category/response	1990 (N = 296) %	2007 (N = 2007) %
Never	14.3	16.4
Once/month	25.5	21.8
Once/week	20.8	20.6
2 x/week	16.6	18.2
More than 3x/week	22.8	23.0
^a $\chi^2 = 1.98, df=4, ns$		

found that knowledge scores and frequency of sunbathing were unrelated and, interestingly, students who reported having used a tanning salon had higher knowledge and a more healthful attitude about sunbathing. This indicates that knowledge of the harmful effects of sunbathing does not necessarily contribute to healthy actions such as avoiding the use of indoor UV tanning beds, which is consistent with the findings in prior research.^{8,14,15,19}

Women in the both the 1990 and 2007 surveys had more knowledge of the harmful effects of tanning than their male counterparts. This could be because women tend to tan more often than men and thus, become more informed about the subject. This is consistent with results reported in other studies, which found that women had more knowledge of the harmful effects of tanning than their male counterparts and tended to engage in more sun protective behaviors, including use of sunscreen.^{8,14,15,19,38}

Respondents to the 2007 survey generally reported less favorable attitudes toward tanned skin compared to our 1990 sample of respondents. Fewer respondents in 2007 agreed that they looked better or more attractive with a suntan and that suntans looked healthy. However, despite reporting less positive attitudes toward tanned skin, more 2007 respondents stated that they enjoyed sunbathing than did respondents in 1990, which does not support the effectiveness of skin cancer prevention campaigns.

The proportion of students agreeing that sunscreen was “too expensive to use” also declined from 1990 to 2007, which may be due to the increased availability of different types of sunscreens at a wide variety of prices, especially in discount retail outlets.

Although the percentage of students who reported that they rarely, if ever, used sunscreen dropped substantially from 1990 to 2007 (from 50% to 27%), the percentage who reported using sunscreen with an SPF of at least 15 when they were exposed to the sun for at least one half hour improved less dramatically (from 9% to 22%). These findings are consistent with those of Koh et al.,³⁹ who found in a large-scale study that roughly a third of adults engage in sun protective behaviors. Similar results were also found in other research studies.^{6,15,29,40} While our 2007 findings show that some progress is being made toward the Healthy People 2010 goal of increasing to 75% the number of people who use at least one of the recommended protective measures to reduce the risk of skin cancer, much still remains to be accomplished in attaining this goal in the college student population.

The study results show the percentage of respondents reporting family history for skin cancers increasing from 1990 to 2007, and more women than men reporting a higher prevalence of family history for skin cancer in both studies. These findings could have implications regarding the students’ skin cancer risk perceptions. Having a friend or

relative who has been diagnosed with cancer is an important factor related to increased awareness and perceived risk, as confirmed by Mellon et al.,⁴¹ who found that relatives of those who had breast or ovarian cancer had a higher level of perceived risk than the survivors themselves or others.

Approximately 60% of the respondents in both our 1990 and 2007 samples reported sunbathing at least once a week in the summer, which is substantially higher than findings by Kho et al.³⁹ and others who report that 25% of the adults indicated they sunbathed frequently.^{11,13} It should be noted that our study respondents live in fairly close proximity (an hour and a half drive) to the Atlantic coast, where going to the beach and outdoor activities such as boating, surfing and other water activities are popular pastimes.

We did not assess whether our participants actually had been exposed to any education campaigns. However, our results suggest that little improvement in sun protection practices has been achieved in this population of young adults in the past 17 years despite educational efforts to inform the public of the harmful effects from excessive and intentional sun exposure. It appears that despite increased awareness of the harmful effects of repeated sun exposure, high-risk behavior continues among young adults, presenting a continual challenge among health educators.^{6,17,23} Unfortunately, despite targeted initiatives and strategies to increase knowledge levels of the harmful effects of intentional sun exposure, young adults are not changing their attitudes toward sun exposure or altering their tanning behavior.^{6,14-22} While many health education prevention efforts have been implemented, few have resulted in an increase in health knowledge. Through these programs, support for actual behavior change is minimal and the majority of U.S. young adults, including those in our sample, continue to engage in high levels of sun exposure with limited protection.^{6,9,12-17} However, some of our findings show promise, such as the slight increase in protective behaviors that are more closely aligned to the Healthy People 2010 goal.



Table 5. Differences in Mean Attitude Scores as a Function of Frequency of Sunbathing for 2007 Respondents and Concordance with 1990 Results

Attitude	Frequency of Sunbathing		t-value	Concordance with 1990 data
	Once per week or less	Two times per week or more		
Desirability of tanner skin/tanning				
"I look better with a suntan"	3.69	4.37	-7.956 *	Yes
"I enjoy sunbathing"	2.65	4.22	-18.145 *	Yes
"Suntans look healthy"	3.15	3.77	-8.50 *	Yes
"I look thinner with a suntan"	2.73	3.34	-6.713 *	No
"Suntanned skin is more attractive than skin that is not tanned"	3.46	4.03	-6.897 *	Yes
Concern with negative effects of sun exposure				
"I'm not worried about getting skin cancer"	2.62	2.49	1.507	Yes
"I'm not worried about the possibility of sun exposure causing my skin to age prematurely"	2.41	2.37	0.465	Yes
"It's important for me to have a tan now, I'll worry about wrinkles resulting from sun damage later"	2.18	2.92	-8.715 *	Yes
Utilization of sunscreens				
"Sunscreens are too messy to use on a regular basis"	2.34	2.49	-1.528	Yes
"Sunscreens are too expensive to use on a regular basis"	2.01	1.94	0.798	Yes
* $P < 0.05$ Note: $N = 596$				

TRANSLATION TO HEALTH EDUCATION PRACTICE

The study findings provide college health educators and other cancer prevention professionals with information that should be considered when developing interventions to reduce skin cancer risk in a college student population. The lack of risk behavior change across the 17-year period our data spans suggests that intervention programs that have or are occurring have either not reached these individuals or have not had the desired impact if they did. Specifically, we found that knowledge about intentional sun exposure risks was not related to frequency of sunbathing. The one important exception

was the finding that those who reported using tanning salons actually had higher knowledge scores. Consequently, educational interventions focusing on increasing knowledge of sun exposure risk are not likely to be effective in altering risk behavior.

Second, although significantly fewer 2007 respondents reported they looked better or more attractive with a suntan than did the 1990 respondents they did not report reduced intentional sun exposure. In fact, more 2007 respondents reported enjoying sunbathing. In 1990 we wrote, "It appears that the perception of a tan as attractive and socially desirable is a formidable obstacle to overcome in reducing intentional sun expo-

sure." However, our 2007 findings indicate that even when college students lower their opinion of tanned skin, they do not decrease risky behavior.

Third, sunscreen use did increase significantly during the seventeen years since the first study was done. This is a specific behavior that is relatively easy to comply with. It also might be seen as behavior that enables the enjoyable (albeit risky) behavior of sunbathing as discussed above.

Our general finding, that skin cancer risk behaviors had changed little despite almost two decades of intervention programs, supports the conclusions of Naylor and Robinson⁴⁵ who reviewed those ef-



forts and found them largely ineffective. Reacting to these findings, Hillhouse and Turrisi^{46(p1031)} wrote that “one critical fact we have learned in the past 20 years of prevention work is that seemingly simple behaviors are really quite complex in terms of motivation, decision making and environmental context.” Our finding that even when tanning attractiveness declines intentional sun exposure does not indicate of the complexities associated with altering these behaviors.

Our results support, what appears to be the emerging consensus, that individual interventions that focus exclusively on risk avoidance are not likely to be effective. What are the alternatives? According to evidence-based programs implemented in Australia, the most effective initiatives are those that combine public health education campaigns with policy and environmental strategies that are integrated across state, regional and local levels. In Australia, effective education and awareness initiatives have been centered on school health programs (policy requirements of items the student must bring to school including sunscreen SPF 30 and hats and advisories to teachers to schedule outdoor activities when the sun is less intense), sport and recreation groups (education and resources of sunscreen and proper clothing available), workplaces (where marketing campaigns are posted and free samples of sunscreen and lip balm are provided) and with practitioners (via screening and education efforts). The educational component is coupled with behavior change strategies to improve self-protection behaviors including encouraging utilization of sunscreen of SPF 30 or above, wearing sun glasses, hats, protective clothing, and staying in the shade during the time of day when the sun is the most intense.⁴⁷⁻⁵¹ Of course, these programs require public policy changes and the public’s support to implement such initiatives.

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