BRIEF COMMUNICATION

Use of Tanning Devices and Risk of Basal Cell and Squamous Cell Skin Cancers

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Use of artificial tanning devices that emit UV radiation, such as tanning lamps and tanning beds, has become increasingly popular in the United States. Although an excess risk of nonmelanoma skin cancers might be predicted from this exposure, little epidemiologic data exist. We conducted a population-based, case–control study that included 603 basal cell carcinoma (BCC) case patients, 293 squamous cell carcinoma (SCC) case patients, and 540 control subjects. Study participants were interviewed in person to obtain information on tanning device use, sun exposure history, sun sensitivity, and other risk factors for skin cancer. Overall, any use of tanning devices was associated with odds ratios of 2.5 (95% confidence interval [CI] = 1.7 to 3.8) for SCC and 1.5 (95% CI = 1.1 to 2.1) for BCC. Adjustment for history of sunburns, sunbathing, and sun exposure did not affect our results. Our findings suggest that the use of tanning devices may contribute to the incidence of nonmelanoma skin cancers. They highlight the need to further evaluate the potential risks of BCC and SCC that are associated with tanning lamp exposure and the appropriate public health response. [J Natl Cancer Inst 2002;94: 224–6]

The use of artificial tanning devices, such as sunlamps, for nonmedical purposes has gained widespread popularity, especially among young adults and women. These devices frequently elicit an erythemal (sunburn) response in users *(1–3)*. Solar UV radiation (UVR) and sunburns are risk factors for all three of the common types of skin cancer: basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and melanoma *(4)*. Thus, although an excess risk of skin cancer might be expected among those who use artificial tanning devices *(5–8)*, epidemiologic data are sparse for BCC and SCC *(4)* and suggestive, but not definitive, for melanoma *(9)*. Because of the potential impact of tanning lamp use on public health, we investigated the risk of BCC and SCC associated with such use in a population-based, case–control study conducted in New Hampshire.

The methods of case ascertainment and the general case–control design of our study appear in previous reports *(10,11)*. Briefly, we identified newly diagnosed BCC and SCC cases through a collaborative network of dermatologists and pathology laboratories throughout New Hampshire and its bordering regions *(10)*. Eligible study participants consisted of a randomly selected sample of BCC patients and all of the SCC cancer patients who were diagnosed from July 1, 1993, through June 30, 1995, were aged 25–74 years, and were residents of New Hampshire at the time of diagnosis. Control subjects were New Hampshire residents aged 25–74 years drawn from a listing provided by the New Hampshire Department of Transportation (for those subjects <65 years old) and the Medicare Program of the Centers for Medicare and Medicaid Services (for those subjects ⩾65 years old). Control subjects were frequency matched by age and sex to represent the combined distribution of the SCC and BCC case subjects. We interviewed 603 BCC case subjects, 293 SCC case subjects, and 540 control subjects for the study; response rates were 78% among case subjects and 66% among control subjects.

We conducted structured personal interviews to obtain sociodemographic information (i.e., level of education) and information about each participant's sun sensitivity (i.e., tendency to sunburn), sun exposure (e.g., time spent outdoors, history of sunbathing, and number of painful sunburns), previous radiation treatment, and tobacco use. We asked participants if they ever used a sunlamp or a tanning bed or patronized a tanning salon. For those who had done so, we specifically asked their ages at first and last use. The interview contained separate questions regarding radiation and UV therapy to avoid misclassification of these exposures. We did not reveal the specific hypotheses of interest or the case–control status of participants to either the interviewer or the participant before the interview. Each participant provided informed consent in accordance with the Committee for the Protection of Human Subjects at Dartmouth College, which approved the study.

Using unconditional logistic regression and taking into account multiple confounding factors *(12)*, we computed the odds ratios (ORs) and 95% confidence intervals (CIs) of BCC and SCC associated with the use of tanning devices before the diagnosis date of the case subjects and a comparable date assigned to control subjects. We included age and sex in all models and assessed the potentially confounding or modifying effects of skin reaction to 1 hour of sunlight for the first time in summer (severe sunburn with blistering, painful sunburn with peeling, mild sunburn with some tanning, or tanning with no sunburn), number of hours per week spent outdoors during the summer, number of painful sunburns, frequency of sunbathing, radiation treatment (no or yes), cigarette smoking history (never, former, or current), and level of education (less than college, college, or graduate/professional school). Ultimately, all relative risk estimates of SCC were adjusted for age, sex, and sun sensitivity. Risk estimates of BCC were adjusted for age and sex only because the addition of sun sensitivity did not alter the results. No other factors, including summer outdoor exposure, sunbathing, or sunburns, affected our results. We tested for a trend in the ORs according to continu-

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Table 1. Prevalence of tanning lamp use among study participants

Characteristics	Skin cancer patients		Control subjects	
	Men (n = 527), No. (%)	Women (n = 366), No. (%)	Men (n = 325), No. (%)	Women (n = 214), No. (%)
Any use of tanning devices	86 (16.3)	104 (28.4)	30 (9.2)	45 (21.0)
Age, y				
⩽50	26 (29.6)	48 (45.7)	7 (13.7)	29 (47.5)
51–60	15 (16.0)	24 (32.4)	9 (15.3)	8 (19.5)
61–70	33 (14.2)	24 (21.1)	9 (5.9)	7 (9.1)
>70	12 (10.7)	8 (11.0)	5 (7.9)	1 (2.9)
Skin reaction to strong sunlight for the first time in summer for 1 h*				
Severe or painful burn with peeling or blistering	38 (18.9)	47 (27.0)	11 (11.5)	16 (21.1)
Mild burn and tanning	45 (16.0)	49 (30.1)	17 (10.6)	29 (26.9)
Tanning with no burn	3 (7.0)	8 (27.6)	2 (3.0)	0 (0.0)
Average No. of times sunbathing per year†				
⩽4	36 (11.2)	14 (12.6)	13 (6.2)	6 (7.0)
>4	50 (25.1)	87 (35.7)	16 (15.2)	39 (31.7)
No. of painful sunburns in lifetime‡				
0–1	26 (12.5)	42 (26.9)	6 (4.0)	17 (14.9)
⩾2	60 (19.2)	59 (29.7)	23 (13.9)	27 (28.7)

*Five men, who did not report tanning lamp use, had missing data.

†Sunbathing data were missing for 13 men and 13 women who did not report tanning device use and for one man and three women who reported using tanning devices.

‡Sunburn data were missing for 14 men and 13 women who did not report tanning device use and for one man and four women who reported using tanning devices.

ous exposure variables (e.g., age at first use) using a continuous term in a logistic regression model restricted to those who reported using tanning devices *(12)*.

Study subjects who reported using tanning devices were more likely to be female, to be 50 years of age or younger, to have a sun-sensitive phenotype, to have more painful sunburns, and to have sunbathed more than four times per year (Table 1). Overall, we found that the use of tanning devices was associated with an OR of 2.5 (95% CI = 1.7 to 3.8) for SCC and an OR of 1.5 (95% CI = 1.1 to 2.1) for BCC. These effects were similar in men and women (data not shown). Although the ORs for BCC and SCC were highest among those who began using tanning devices before age 20 years, before 1975, or 20 or more years before being diagnosed with skin cancer, these trends (based on 75 control subjects, 127 BCC case subjects, and 63 SCC case subjects who reported tanning lamp use) did not achieve statistical significance in our data (Table 2). Using a continuous scale, we found that the ORs for SCC and BCC increased by 20% (OR = 1.2; 95% CI = 0.9 to 1.6; two-sided *P* for trend = .15) and 10% (OR = 1.1; 95% CI = 0.9 to 1.4; two-sided *P* for trend = .46), respectively, for each decade younger the subject was at first use of a tanning device (data not shown).

Table 2. Odds ratios (ORs) and 95% confidence intervals (CIs) for basal cell carcinoma and squamous cell carcinoma associated with the use of tanning devices

Tanning device use	Control subjects (n = 539), No. (%)	Basal cell carcinoma cases (n = 601)		Squamous cell carcinoma cases (n = 292)	
		No. (%)	OR (95% CI)	No. (%)	OR (95% CI)
Any use					
No	464 (86.1)	474 (78.9)	1.0 (referent)	229 (78.4)	1.0 (referent)
Yes	75 (13.9)	127 (21.1)	1.5 (1.1 to 2.1)	63 (21.6)	2.5 (1.7 to 3.8)
Age at first use, y					
No use	464 (86.1)	474 (78.9)	1.0 (referent)	229 (78.4)	1.0 (referent)
<20	23 (4.3)	46 (7.7)	1.8 (1.0 to 3.0)	24 (8.2)	3.6 (1.9 to 6.9)
20–35	26 (4.8)	42 (7.0)	1.4 (0.8 to 2.3)	20 (6.9)	2.8 (1.4 to 5.5)
>35	26 (4.8)	39 (6.5)	1.4 (0.8 to 2.3)	19 (6.5)	1.7 (0.9 to 3.2)
Test for trend*			*P* = .46		*P* = .15
Year of first use					
No use	464 (86.1)	474 (78.9)	1.0 (referent)	229 (78.4)	1.0 (referent)
Before 1975	44 (8.2)	75 (12.5)	1.6 (1.1 to 2.3)	48 (16.4)	2.9 (1.8 to 4.7)
1975 or later	31 (5.8)	52 (8.7)	1.4 (0.8 to 2.2)	15 (5.1)	1.7 (0.9 to 3.5)
Test for trend*			*P* = .49		*P* = .17
Time since last use, y					
No use	464 (86.1)	474 (78.9)	1.0 (referent)	229 (78.4)	1.0 (referent)
<10	28 (5.2)	46 (7.7)	1.3 (0.8 to 2.2)	15 (5.1)	2.1 (1.0 to 4.3)
10–19	11 (2.0)	22 (3.7)	1.8 (0.8 to 3.7)	9 (3.1)	2.5 (1.0 to 6.6)
⩾20	36 (6.7)	59 (9.8)	1.5 (1.0 to 2.4)	39 (13.4)	2.7 (1.6 to 4.5)
Test for trend*			*P* = .61		*P* = .41

*Trend test based on a continuous exposure variable based on exposed individuals.

Whereas several case reports have implicated the use of tanning devices in the pathogenesis of BCC and SCC *(5–8)*, only sparse epidemiologic data exist to support these associations. In the 1980s, two hospital-based studies from Dublin, Ireland *(13,14)*, and one population-based study of men in Alberta, Canada *(15)*, found no association between exposure to artificial sources of UVR and nonmelanoma skin cancer. The subjects in these studies had a relatively low prevalence of use, and only crude measures of exposure to tanning devices were reported (e.g., no quantitative information on timing or frequency of use was reported). In a hospital-based study from Montreal, Quebec *(16)*, four

of 92 SCC case subjects diagnosed from 1977 to 1978 reported using sunlamps, compared with one of 174 control subjects (OR = 13.42). Our findings that the relative risk estimates for SCC and BCC steadily increase with early ages at first exposure to tanning devices parallel those of the melanoma studies *(9).* To our knowledge, the effects of the timing of exposure to artificial UVR from tanning devices has not been explored in previous nonmelanoma skin cancer studies. We could not separate the effects of age at exposure from those of latency (i.e., years since exposure) because of limited statistical power, nor could we evaluate what effects the frequency of tanning lamp use and the amounts of UVB or UVA emissions had on study participants. Clearly, these important issues require further investigation.

Each of the common types of skin cancer has increased in incidence in recent decades *(10,17).* Our data are consistent with earlier suggestions that the use of tanning devices may contribute to the incidences of BCC and SCC. Because BCC and SCC together is the most common malignancy in the United States with associated mortality and substantial morbidity, we must consider an appropriate public health response. Given that recent studies have found that up to 51% of high school-aged girls report using a commercial tanning bed at least four times in the past 12 months *(2),* suggestions have included preventing minors from using these devices and requiring written informed consent from adults seeking to use them.

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NOTES

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