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Sunbeds and sunlamps: who used them and their risk for melanoma

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Summary

Sunbed/sunlamp use was recently classified as carcinogenic. This report considers characteristics of those who use sunbeds/sunlamps and the effect of sunbed/sunlamp use on their risk for melanoma within a large case-control study carried out in 1991–2. Females were more likely than males to have used sunbeds/sunlamps. Use by females increased strongly and significantly with younger ages and with the perceived ability to tan. For females the individual risk for melanoma increased with typical session time and frequency of sessions. Use before age 20, current use and years of use were not significant. The use patterns of occasional and frequent users were very different. We estimate that typical 5 minute sessions would increase the risk for melanoma by 19% for frequent users (10+ sessions) and by 3% for occasional users (1–9 sessions). Body sites that are not generally exposed to sunlight were more common sites of primary melanomas for frequent sunbed/sunlamp users. For males, measures of sunbed/sunlamp use were not significantly associated with melanoma risk.

Keywords

sunbeds/sunlamps; risk factor; melanoma; UVR; dysplastic nevi

INTRODUCTION

Exposure to ultraviolet radiation (UVR) from the sun is generally recognized to be the major environmental risk factor for melanoma (Gandini et al., 2005; National Institutes of Health, 1991). The wavelengths of UVR between 100–280nm, called UVA, and those between 280 and 315nm, called UVB, have been classified as human carcinogens by the International Agency for Research on Cancer (IARC) (El Ghissassi et al., 2009) and carcinogens by the National Toxicology Program (NTP) (National Toxicology Program, 2002).

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Artificial sources of UVR have long been available but early sunlamps provided primarily UVB and were used infrequently and in the home. In the 1980s commercial establishments appeared and today tanning facilities are readily available, indeed more common even than either Starbucks or McDonalds (Hoerster et al., 2009). Commercial tanning equipment generates primarily UVA with UVB making up less than 5% of the total output (El Ghissassi et al., 2009; Gallagher et al., 2005).

Despite the relative paucity of UVB output by modern tanning equipment relative to solar radiation, the use of such equipment as a risk factor and causal agent for melanoma has been addressed in a number of studies. Two reviews (El Ghissassi et al., 2009; Gallagher et al., 2005) concluded that risk of cutaneous melanoma is increased with indoor tanning. Further, studies of sunbeds/sunlamps have adjusted for sun exposure as a confounder (a surrogate for sun-seeking behaviors) in their analyses. However, the adjustments were for variables that measure specific intermittent exposures such as sunburns or sunny vacations (Chen et al., 1998; MacKie et al., 1989; Naldi et al., 2000; Veierod et al., 2003; Walter et al., 1999; Westerdahl et al., 1994; Westerdahl et al., 2000). A recent study report from the Skin Health Study (Lazovich et al., 2010) adjusted for measures of lifetime typical hours out, hours of physical activity and hours out during outdoor jobs. However, these measures were each not statistically significant and generally suggested weak protective effects for UVR exposure. Variables that are generally regarded as causal and are well estimated should be included in causal models to improve precision of estimates and/or improve the power of statistical tests. This is the case whether or not the variables are confounded with the variable of interest.

For this paper we used data from a large matched case-control study of melanoma that was carried out between January, 1991, and December, 1992. The design of the study emphasized the assessment of risk associated with nevi and with exposure to outdoor ambient UVR. We previously reported that clinically defined dysplastic nevi (DN) are an important risk factor for melanoma (Tucker et al., 1997) and we estimated the association of melanoma risk with individual residential UVB history and time outdoors based on a six monthly occupational history from personal interviews (Fears et al., 2002). Our data are unique in having strong, significant results for these important melanoma risk factors and in addition for other phenotypic factors such as total number of nevi, large nevi, freckles and chronic solar damage, for environmental factors such as average residential UVR flux, hours outdoors, number of painful adult burns, and tan type, and for genetic background in terms of family and also personal history of melanoma.

Several exploratory sunbed/sunlamp questions were included in our study and the results of those questions are today both timely and important. In this report we first describe with some detail the individual characteristics of those who chose to use sunbeds/sunlamps and those who used sunbeds/sunlamps most often. Understanding the patterns of use and characteristics of those who use sunbeds/sunlamps may help tailor public health messages to modify their sun seeking behaviors. Next we used factors emphasized in our study to ask if the use of tanning equipment was a risk factor for melanoma after adjusting for significant positive measures of cumulative exposure to sunlight and the presence of dysplastic nevi. Finally, since the use of sunbeds/sunlamps increases UVR exposure at body sites that are usually protected (Bulliard et al., 2000), we also compared the site distribution of melanoma cases for those who used and did not use sunbeds/sunlamps.

RESULTS

Sunbed/sunlamp Use

To describe the individual characteristics of those who used sunbeds/sunlamps we considered measures of sunbed/sunlamp use: ever/never used a sunbed or sunlamp, the total number of sessions (reported in categories of zero, less than 10 times, 10–50 times or greater than 50 times); and typical session times reported in minutes (Table 1).

Ever/never used a sunbed/sunlamp—Overall, females were more likely to use sunbeds/sunlamps than males (P<0.01, estimated relative odds, RO=1.5, confidence interval, CI: 1.2, 1.8). Because melanoma risk factors (Fears et al., 2006) and light exposure differ by gender (Fears et al., 2002), we considered sunbed/sunlamp usage separately for males and females. Factors that were possibly associated with the use of sunbeds/sunlamps included study site, ten year age groups, burn reaction at first sun exposure, burn reaction after one week of exposure, tan response after prolonged sun exposure, complexion, eye color and hair color.

Ever usage among females (Table 1) did not differ significantly by case-control status (P=0.13) or study sites (P>0.50) but decreased with age group (P<0.01). Adjusting for study site, age group, and case-control status (Table 2), usage increased significantly with tan response after prolonged sun exposure (P<0.01). Compared with the odds of usage by those who could get no tan, the estimated relative odds for usage was 1.5 for those who tanned lightly (CI: 0.7, 3.3); 2.1 for those who tanned moderately (CI: 1.0, 4.7); and 4.2 for those who tanned deeply (CI: 1.8, 9.4). Usage decreased with the reported severity of burning after one week of exposure (P<0.01). Compared with the odds of usage by those who got a severe or painful burn, the relative odds was 1.8 (CI: 1.1, 3.0) for those with a mild burn and 2.2 (CI: 1.4, 3.6) for those with no burn. Usage was not generally associated with burn type at first exposure (P>0.16) but did decrease with severity of burn among cases (Table 2). Those with light complexion were less likely to use sunbeds/sunlamps compared with those with a medium or dark complexion. The estimated relative odds was 0.7, (CI: 0.5, 1.0). Those with dark eyes used sunbeds/sunlamps more than those with light eyes. The estimated relative odds was 1.5 (CI: 1.1, 2.0). Usage was not associated with hair color (P>0.50).

There were few strong patterns in the use of tanning beds by males. Ever usage was similar for cases and controls (P>0.29) and at the two study sites (p>0.50) but decreased with age groups (P>0.04) as seen in Table 2. Burn reaction after one week of exposure and tan reaction after prolonged exposure were not associated (P>0.30) with sunbed/sunlamp use by males (Table 2). Hair color, complexion and eye color were also not associated with sunbeds/sunlamps (P>0.40). Usage variability was associated with burn response (Table 2) after first time exposure (P=0.03) but the usage increased with degree of burn response ($P \leq 0.01$).

Frequency of sunbed/sunlamp use—Among all respondents who were sunbed/sunlamp users, fifty-four percent had used a sunbed/sunlamp less than ten times, 38% had used a sunbed/sunlamp 10–50 times and only 8% (12 male controls and 5 cases, 15 female cases and 6 controls) had used a sunbed/sunlamp more than 50 times. Because of the small numbers, we pooled those who had used a sunbed/sunlamp ten or more times (Table 2). We refer to the two groups as occasional users (1–9 times) and frequent users of sunbeds/sunlamps (10 or more times).

Among males who used a sunbed/sunlamp or a sunlamp, the odds of more frequent use did not differ significantly by case-control status (P>0.50); study site (P>0.50), age group (P>0.50), burn reaction at first exposure (P=0.28), burn reaction after one week of exposure

(P=0.32), tan reaction after prolonged exposure (P=0.34), complexion (P=0.29), eye color (P>0.50) or hair color (P=0.23).

Among females who used a sunbed or a sunlamp, the odds of more frequent use did not differ significantly by case-control status (P=0.50); study site (P>0.50), or age group (P>0.50), The odds of more frequent use varied significantly with burn reaction at first exposure to strong summer sun (P<0.01). Compared to the odds of more frequent use by those who get a painful burn, the estimated relative odds of more frequent use was 4.2 (CI: 1.8, 9.7) for those with no burn and 2.5 (CI: 1.3, 4.7) for those with a mild burn. The trend was significant (P<0.01). Similarly, the odds of more frequent use varied significantly with burn reaction to strong summer sun after one week of exposure (P<0.01). Compared to those who get a painful burn, the estimated relative odds was 3.9 (CI: 1.5, 9.7) for those with no burn and 1.9 (CI: 0.7, 4.8) for those with a mild burn. The trend was significant (P<0.01). The odds of more frequent use differed significantly (P=0.05) with complexion. Compared to those with medium or dark complexion, the estimated relative odds for those with a light complexion was 0.6 (CI: 0.3, 1.0). The odds of more frequent use did not differ significantly by tan reaction after prolonged sun exposure (P>0.50), eye color (P=0.25) or hair color (P=0.40).

Typical session times during sunbed/sunlamp use—The typical session times were reported in minutes and varied from one minute to one hour but 97% were thirty minutes or less. Common session times were multiples of 5 minutes. Tertiles of session time were similar for males and females so for analysis we used 0–9 minutes, 10–19 minutes, and 20+ minutes as the polytomous variables for multiple logistic regressions. The odds of longer session times were significantly less in Philadelphia compared to San Francisco for both males (P<0.01) and females (P<0.01). The estimated relative odds for 20+ minutes compared to 0–9 minutes was 0.2 for males (CI: 0.1, 0.5) and 0.3 for females (CI: 0.1, 0.5). The estimated relative odds for 10–19 minutes compared to 0–9 minutes was 0.5 for males (CI: 0.2, 1.0) and 0.3 for females (CI: 0.2, 0.7). Odds for longer session times decreased significantly with age group for females (P<0.01) but not for males (P=0.42). Session times by males and by females were not associated with tan reaction after prolonged sun exposure (P>0.20), burn reaction at first sun exposure (P>0.50), burn reaction after 1 week of exposure (P>0.19), complexion (P>0.23), eye color (P>0.50) and hair color (P>0.40).

Sunbed/sunlamp use as a risk factor for melanoma

In evaluating sunbeds/sunlamps as a risk factor for melanoma ever/never used a sunbed or sunlamp, the total number of sessions (zero, less than 10 times, 10–50 times or greater than 50 times) and typical session times in minutes, age at first use (< 20 years, ≥ 20 years), current user (within 2 years of interview), and the number of years of use (Table 1) were considered as measures of sunbed/sunlamp exposure.

For females, use before age 20 years (P=0.10), current use (P=0.09) and years of use (P>0.50) were not significant after adjustment for average residential UVR flux, hours outdoors, tan type, presence of DN (Fears et al., 2002; Tucker et al., 1997) and number of painful adult burns. The estimated relative odds of melanoma was 0.8 (P=0.30) for occasional users (less than 10 sessions) and 1.1 (P>0.50) for more frequent users (10+ sessions). This difference in estimated relative odds for user types was not significant (P>0.50). The overall association of typical session times and melanoma risk was not significant (P=0.26).

The use patterns of occasional and frequent users were very different. For at least 73% of occasional users, the sunbed/sunlamp use was for only one year. Median typical session times were 10 minutes for females and 14 minutes for males. For the frequent users, only

20% were one year users and more than half had used sunbeds/sunlamps for more than 4 years. Median typical session times were 20 minutes for females and 15 minutes for males. We considered the effect of session times separately for occasional and frequent users. For more frequent users the estimated effect of typical session times was positive and significant (P=0.04) while, for occasional users, the estimated effect of typical session times was small and not significant (P>0.50). The significance level of the difference in effects of session time for occasional users and frequently users was P=0.06.

Our final model of risk for melanoma for females and exposure to sunbeds/sunlamps included a single term for ever/never used a sunbed/sunlamp and terms for typical session times for occasional users and for more frequent users. There also were adjustments for average residential UVR flux, hours outdoors, number of painful adult burns, tan type and the presence of DN. Model results are summarized in Table 5. We estimate that the effect of five minute typical sessions or increasing typical sessions by five minutes (the RO5) would be to increase the risk of melanoma by 3% (CI: −14%, +23%) for occasional users and by 19% (CI: 2%, 38%) for more frequent users.

For males, the measures of sunbed/sunlamp use were not significant after adjustment for average UVR flux, hours outdoors, tan type, the presence of confirmed dysplastic nevi, and the number of painful adult burns,. Individual significance levels were each greater than 0.15. The estimated relative odds of melanoma for those who had used sunbeds/sunlamps compared with those who did not was 0.9 (P>0.50).

The estimated relative odds for occasional and more frequent users was not significant (P≥0.35) and did not differ significantly (P>0.50). The association of typical session times and melanoma risk was not significant (P=0.15) and did not differ significantly for occasional and more frequent users (P=0.11). A five minute typical session time or an increase of five minutes in typical session times was estimated to result in a 7% decrease in the odds for melanoma (CI: −15%, +2%).

Sunbed/sunlamp use and melanoma site—As a generality, the head, shoulders, arms, and upper torso of males and head, shoulders, arms, upper back, and legs of females are occasionally to commonly exposed to sunlight. Other body sites are not generally exposed to sunlight but may be routinely exposed to the UVR of sunbeds/sunlamps.

Table 4 provides the frequency and percentage of melanoma cases with first excision sites not generally exposed to sunlight for those who never used sunbeds/sunlamps, those who used sunbeds/sunlamps occasionally (1–9 times) and those who used them more frequently (10+ times). The proportion of cases at low exposure sites was notably increased for females who had used sunbeds/sunlamps more frequently, 43% compared with 23% for never used and 26% for occasional users. We used logistic regression to consider variable association with the odds of the more exposed sites. For females, study site (P=0.42), continuous age group (P=0.12), adult hours outdoors (P=0.46) and tan type (P=0.75) were not significant. Frequent sunbed/sunlamp use was significant, est RO=2.6 (95% CI, 1.3,5.1).

DISCUSSION

These data indicate that the individual risk of melanoma for females increased with typical session times among both those who are occasional and frequent users of sunbeds/sunlamps. The occasional users in this study used a sunbed/sunlamp fewer than 10 times and generally for less than one year. We estimated that typical sessions of five minutes would increase melanoma risk by 3% for these users. A frequent user was one who had used a sunbed/sunlamp at least ten times and in this study 20% of them had used a sunbed/sunlamp more

than 50 times. The median years of use was 4 years but 10% had used sunbeds/sunlamps for at least 18 years. We estimated that typical sessions of 5 minutes for these frequent users would increase melanoma risk by 19%.

It was surprising that use of sunbeds/sunlamps by males was not associated with an increase in risk for melanoma. Nevertheless, this gender-specificity is in accord with recent epidemiologic findings. Purdue and colleagues (Purdue et al., 2008) evaluated melanoma incidence patterns in teenagers and adults younger than 40 years. The incidence rates of melanoma for young men have been relatively constant since 1980 while the rates for young women increased more than 2.5% per year from 1973 to 1987 and then again from 1992 to 2004. Previously (Fears et al., 2002) we found that outdoor exposure was generally much higher for males than for females. Only females who believed they could get a deep tan had average outdoor exposure that was comparable to that of males.

In this report we found that 20 years ago, younger females used sunbeds/sunlamps more than younger males. Females who believed they would get a deep tan were more likely to use a sunbed/sunlamp and more likely to be a frequent user than those who do not believe they would get a deep tan. In our study, it appears that females who believed that they could tan were sun seekers. They were more likely to use sunbeds/sunlamps and their outdoor exposure was high, comparable to that for males. For our analysis, the adjustment for UVR and exposure history was therefore particularly important for the conclusions. Coelho and Hearing (Coelho and Hearing, 2010) have hypothesized that the intermittent use of large amounts of UVA from sunbeds/sunlamps along with higher solar exposures may have a particularly important role in the continued increase of melanoma incidence among females.

Detailed information about respondents' characteristics was available based on questionnaire and skin exams, allowing us to describe features of sunbed/sunlamp users. Females were more likely than males to have used sunbeds/sunlamps and their usage decreased from about 50% to 15% with participants' increasing age. Use by females increased strongly with perceived ability to tan and use was greatest among those who could develop a deep tan. Those with a medium or dark complexion were more likely to be users than those who were fair. Among users, those who burn were also more likely to be occasional users. Use of a sunbed/sunlamp among males ranged from 16% to 32% and was not associated with age group, tan type, burn type or complexion. For males, skin characteristics were not significantly associated with sunbed/sunlamp use or its frequency.

Our study is unique in having DN status based on clinical skin exams. One confirmed DN was associated with a two-fold risk and ten or more were associated with a 12-fold increased risk. In our study more than half of the cases had clinically confirmed DN. Risk for melanoma is strongly related to clinically dysplastic nevi and it is important that our estimates were adjusted for DN status.

Body sites that are not generally exposed to sunlight may be routinely exposed to UVR by sunbed/sunlamp use or other sun seeking behavior like sunbathing. These sites are relatively more common sites of primary melanomas for frequent sunbed/sunlamp users who are female than for occasional users or non-users. Bradford (Bradford et al., 2010) has found that rates of melanomas on the trunk among younger women are increasing more rapidly than other sites. Purdue et al found that among women age specific incidence increased in birth cohorts starting in 1960–1965, which would correspond to the youngest age group in our case-control study. This is the age group with the highest usage of sunbeds/sunlamps in our study. Our findings may provide insight into the reasons for the increase in recent birth cohorts and the change in the site distribution of melanomas in young women.

Our study has a number of strengths including the robustness of collection of data based on trained, expert interviewers and examiners. It is unique in having extensive data on participants' phenotypic status including DN status and their genetic status in terms of family history of melanoma as well as the background patterns of outdoor exposure to UVB and its intensity. This allowed adjustment for these two important risk factors in considering the effect of sunbed/sunlamp usage on the risk for melanoma. For each respondent we estimated the average possible UVB intensity of exposures from the residence history and the hours outdoors from the complete occupational history. Each participant was examined for DN by physicians and nurses who were uniformly trained and retrained every six months by the same instructor. DN status for each subject was confirmed by an expert senior examiner (Tucker et al., 1997).

We acknowledge several limitations related primarily to our collecting data nearly twenty years ago. For this study, we asked little about the specific types of sunbeds/sunlamps used and we were not able to separate the effects of tanning beds and tanning lamps. This meant that it was not possible to make estimates of the size and nature of exposures. Nevertheless, the output of UVR by the devices addressed in our study is likely comparable to current devices. In 1993, a survey of tanning facilities in North Carolina found UVB was 0.5% to 5.0% of the total light output (Fleischer, Jr. et al., 1993), comparable to that of devices used today. At the time of our study, there was less concern about sunbed/sunlamp use, tanning facilities were widely available but not as common as today, and their use was less frequent. While these considerations led to our asking a narrow range study questions, they likely limited recall error and bias.

A recent report from the Skin Health Study (Lazovich et al., 2010) provides convincing evidence that the current use of sunbeds/sunlamps is an important risk factor for melanoma. Our study was conducted earlier when use of sunbeds/sunlamps was less prevalent and of less duration. Only 30% of our controls had used sunbeds/sunlamps compared to 51% in the Skin Health Study and only 7% on controls had used sunbeds/sunlamps for more than five years compared with 22% of controls in the Skin Health Study. While our estimates of the effects of sunbed/sunlamp use on melanoma risk may be underestimates (perhaps particularly in males), they validate the findings of the Skin Health Study by mitigating concerns of recall bias.

Our data additionally and strongly validate the statement by the International Agency for Research on Cancer (IARC) that sunbeds/sunlamps are carcinogenic in humans. Sunbed/sunlamp use is sun seeking behavior. Understanding the patterns of use and characteristics of those who use sunbeds/sunlamps may help tailor public health messages to modify their sun seeking behaviors.

MATERIALS AND METHODS

The detailed study proposal was approved by the institutional review boards of the National Cancer Institute, Bethesda, MD; Westat Inc., Rockville MD; University of California, San Francisco, CA; and the University of Pennsylvania, Philadelphia, PA. Written informed consent was obtained from each study subject. The study methods were fully described previously (Tucker et al., 1997) and are summarized here. Patients, ages 20–79, with invasive cutaneous melanoma were recruited from those examined at the Hospital of the University of Pennsylvania Pigmented Lesion Clinic and the University of California Melanoma Clinic in San Francisco. Controls were from outpatient clinics with similar catchment areas matched with melanoma patients within strata defined by gender, age, race, and geographic area. The analysis was restricted to non-Hispanic whites and there were 718 cases and 945 controls.

Scripted personal interviews by specifically trained research nurses were used to obtain information about common risk factors, e.g. complexion, tan and burn type, and family history. A skin exam yielded detailed evaluation of small or large moles, freckling, solar damage and dysplastic nevi. Respondents were identified who had ever used a sunlamp or a tanning booth, along with the ages of first and last use, minutes used each time, and the number of times used (1–9 times, 10–50 times, or 50+ times).

Sunbed/sunlamp exposure variables were analyzed using standard statistical methods, including analysis of variance and chi-square tests. The odds of a disease is the probability for the disease divided by the probability against the disease. The relative odds for an exposure variable is the ratio of the odds of disease among those with the exposure and those without the exposure. For a rare disease such as melanoma the relative odds is approximately the relative risk. The relative odds was tested and confidence intervals calculated based on logistic regression analysis with adjustment for age group, study site and case-control status. To estimate relative odds of melanoma and to test hypotheses based on the case-control data matched on age group and study site, we used conditional logistic regression. The evaluation of the tanning bed exposures as a risk factor was adjusted for clinically confirmed dysplastic nevi, the tan type (Fitzpatrick, 1988), the individual average intensity of residential UVB exposure, the number of painful adult burns, and the individual background hours of outdoor exposure (Tucker et al., 1997). Likelihood ratio tests were used for several parameters and Wald tests for individual parameters. All tests are two sided and significant refers to $p \leq 0.05$. All confidence intervals are 95%.

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Table 1

The number and percentage who had used sunlamps or sunbeds/sunlamps in 1991–2, the number of sessions and the length of sessions.

		Males		Females	
		Controls	Cases	Controls	Cases
Ever used a sunlamp or a tanning booth					
Yes	**N**	131	89	151	99
	% all respondents	25.3	22.3	35.4	31.1
No	**N**	386	311	276	219
	% all respondents	74.7	77.8	64.6	68.9
The total number of sunlamp or tanning booth sessions					
1–9 times	**N**	67	42	90	53
	% Users	51.1	47.2	59.6	53.5
10–50 times	**N**	51	39	46	40
	% Users	38.9	43.8	30.5	40.4
50+ times	**N**	12	5	15	6
	% Users	9.2	5.6	9.9	6.1
The typical sessions time (minutes)					
25th percentile		5.5	5.0	8.0	10.0
Median		15.0	12.5	15.0	15.0
75th percentile		25.0	20.0	20.0	25.0
Use before age 20 years					
No	**N**	86	53	70	53
	% Users	65.6	59.6	46.4	53.5
Yes	**N**	45	36	81	46
	% Users	34.4	40.4	53.6	46.5
Current user					
No	**N**	120	83	134	78
	% Users	91.6	93.3	88.7	78.8
Yes	**N**	11	6	17	21
	% Users	8.4	6.7	11.3	21.2

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Table 2

The number and percentage of cases and controls that had used a sunlamp or sunbed/sunlamp in 1991–2 by gender, age group, tan reaction and burn reaction.

	Males				Females			
	Controls		Cases		Controls		Cases	
	N	%Yes	N	%Yes	N	%Yes	N	%Yes
Age at Interview								
20–29	34	32.4	19	31.6	52	48.1	35	60.0
30–39	91	24.2	62	19.4	89	43.8	71	39.4
40–49	119	31.9	107	25.2	102	43.1	93	33.3
50–59	109	25.7	75	24.0	78	33.3	47	23.4
60–69	95	22.1	87	16.1	64	15.6	47	14.9
70–79	69	15.9	50	24.0	42	16.7	25	4.0
All	517	25.3	400	22.3	427	35.4	318	31.1
Tan reaction after prolonged exposure								
deep tan	161	24.2	74	20.3	108	52.8	41	46.3
moderate	236	29.2	206	22.3	186	31.7	129	36.4
light tan	93	17.2	88	26.1	97	26.8	116	25.9
no tan	21	23.8	28	17.9	26	23.1	27	11.1
Burn reaction after 1 week								
severe painful burn	43	25.6	43	32.6	68	26.5	69	18.8
mild burn	172	26.2	163	19.0	144	38.2	122	29.5
no burn	296	24.7	190	23.2	205	36.6	122	41.0
Burn reaction, first exposure								
severe painful burn	99	30.3	86	30.2	120	37.5	101	21.8
mild burn	298	25.2	264	21.2	221	34.4	182	34.6
no burn	114	21.1	46	15.2	76	35.5	30	46.7

Table 3

The estimated increase in risk for melanoma associated with five minute typical sessions or increasing typical sessions by five minutes (the RO5) for occasional and frequent female sunbed/sunlamp users. Adjusted estimates are adjusted for average UVR flux, hours outdoors, tan type, DN, and number of painful adult burns.

	median years of use	median session time	RO5*	(95% CI)
Occasional users				
Adjusted	1 yr	10 min.	+3%	(−14%, +23%)
Unadjusted			+2%	(−13%, +19%)
Frequent users				
Adjusted	4 yrs	20 min.	+19%	(+2%, +38%)
Unadjusted			+12%	(−3%, +28%)

*(exp(5*parameter estimate) – 1)*100.

Table 4

The frequency of melanoma cases at sites not generally exposed to sunlight by frequency of sunbed/sunlamp use in 1991–2 and gender.

		SUNBED/SUNLAMP USE					
		never		occasional		more frequent	
Gender	**site exposure**	**N**	**%**	**N**	**%**	**N**	**%**
Males	Less sun exposed sites	98	32.0	17	43.6	18	40.9
	More sun exposed sites	208	68.0	22	56.4	26	59.1
	all sites	306	100.0	39	100.0	44	100.0
Females	Less sun exposed sites	50	23.1	13	26.0	19	43.2
	More sun exposed sites	166	76.9	37	74.0	25	56.8
	all sites	216	100.0	50	100.0	44	100.0