



ORIGINAL ARTICLE

## Prevalence of sunburn and sun-related behaviour in the Danish population: A cross-sectional study

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### Abstract

**Background:** In Denmark, the incidence of melanoma has been increasing since the 1960s. Intermittent exposure to ultraviolet radiation and a history of sunburn and sunbed use are known risk factors. We describe the association between use of protective measures, sun-related behaviour and experience of sunburn in the Danish population three months after the start of the campaign. **Method:** A population-based sample of 3,499 persons aged 15–59 years completed a questionnaire that included items on exposure to ultraviolet radiation. We examined the relations between sunburn and sun-related behaviour by logistic regression analysis. **Results:** Within the previous 12 months, 35% of the study population had experienced sunburn. Sunburn became less frequent with age (odds ratio (OR) 4.44; 15–19 vs. 50–59) and skin type (OR 2.57; I vs. III). Sunburn was negatively associated with shade and clothing and positively with use of sunscreens. We found no significant difference in sunscreen use between intentional tanners who experienced sunburn and those who did not. A larger fraction of unintentional tanners with sunburn than those who were not sunburnt had used sunscreen. Sunscreen was used to prolong the time spent in the sun by 66% of sunburnt people; however, we found no association between duration of sun exposure and sunscreen use. **Conclusions:** Future campaigns to reduce the prevalence of sunburn in the Danish population must especially target young persons and intentional tanning, and they should emphasize that sunscreen cannot be used to extend the time spent in the sun and that shade and clothing provide the best protection against sunburn.

**Key Words:** *Cross-sectional, melanoma, prevention, questionnaire, sunburn, sunlight, sunscreen, ultraviolet radiation*

### Introduction

Exposure to ultraviolet radiation (UVR) is the main risk factor for most skin cancers [1], and intermittent exposure to UVR from the sun and sunbeds, and sunburn history, are important factors in the aetiology of melanoma [2,3]. Denmark has experienced a marked increase in melanoma incidence (world standardized incidence rate per 100,000, from 1.4 for men and 1.9 for women in 1949–53 to 13.2 in men and 17.0 in women in 2002–06; in 2002–06, melanoma was the cancer that occurred at the highest incidence (13.0) among women aged 15–34 [4]. Intentional tanning became increasingly popular in the second half of the last century, and between 1999 and 2004 the number of people in the Danish population sunbathing between noon and 3 pm increased by 5% [5].

In 2007, a sun protection campaign was launched promoting four strategies to be used in the peak period of exposure to UVR: seek shade, wear a sun hat and use protective clothing, use sunscreen, and do not use sunbeds. Although the campaign advocated use of all these strategies, application of sunscreen was listed as the third best strategy, as it has been shown that use of sunscreen can pose a risk if it is used to extend time in the sun [6].

This paper describes the sun-related behaviour and the prevalence of sunburn in the Danish population three months after the start of a 10-year national sun protection campaign, with annual surveys undertaken to monitor risk behaviour and sun protection in the Danish population and to evaluate the usefulness of the different sun protection advices.

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(Accepted 7 April 2010)

## Materials and Methods

The study was based on a “sun survey” conducted during two weeks in August 2007 among a sample of 4,451 respondents aged  $\geq 15$ . The 65-item questionnaire included questions about sunburn (“How many times have you been sunburnt this summer?”: “More than 5 times, 3–5 times, 1–2 times, Never, Do not know”), protective measures (“Recall this summer at home, on a day off, when the sun is shining between noon and 3 pm: Do you seek shade?; Do you wear a sunhat?; Do you wear light clothing?; Do you use sunscreen?”: “Yes, often, Yes, sometimes; No”), intentional tanning (“Recall this summer at home. The sun is shining and you have the day off. How often did you sunbathe, i.e. were in the sun with the intention to tan”: “I exploited every opportunity to sunbathe (defined as intentional tanners), I sunbathed approximately once a week, I rarely sunbathed, I did not sunbathe, Do not know”), time in the sun (“Recall this summer at home. The sun is shining and you have the day off. How many hours a day were you in the sun between 12:00 and 15:00?”: “Practically never, Less than 30 minutes,  $\frac{1}{2}$ –1 hour, 1–2 hours, 2–3 hours, Do not know”), time extension (“Do you use sunscreen to prolong the time your skin can tolerate the sun”: “Yes, No, Do not know”), location of sunburn, sex, education, age and skin type. Sunburn was defined as any kind of reddening, unpleasantness, pain or blisters on the skin that lasts longer than 12 hours after being in the sun. In addition the questionnaire included questions on sunbed, sunny vacations, knowledge about cancer, children’s sun exposure and attitudes toward sun exposure. The entire questionnaire is available at [www.skrunedforsolen.dk](http://www.skrunedforsolen.dk).

Data were collected on the internet and by telephone interviews. A sample was drawn from an internet panel of approximately 30,000 persons. From the sample, we collected 3,642 interviews; 47% response rate/53% non-response (not available/refused combined). A supplementary group of respondents matched to the Danish population by age, gender and region was then recruited from a list of telephone numbers provided by Statistics Denmark. The supplementary recruitment was carried out as some groups are difficult to reach via internet panels, e.g. very young and elderly persons. Trained interviewers conducted 809 telephone interviews (36% response rate, 30% not reached after six attempts, 26% refused, 3% wrong number and 5% not available in sampling period). Persons aged  $\geq 60$  were under-represented. Due to the biased distribution of this age group persons aged  $\geq 60$  were excluded. The final analysis comprised 3,499 respondents (2,054 female

and 1,445 male) aged 15–59. Skin types were determined from self-assessed tan and sunburn reactions according to Fitzpatrick [7].

Data on sunburn, protective measures and intentional tanning were dichotomized and tested for statistical significance by  $\chi^2$  statistics and logistic regression. Crude and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. For all tests,  $p$  values  $< 0.05$  were considered statistically significant. The procedures `freq` and `logistic` in SAS version 9.1 (SAS Institute, Cary, North Carolina, USA) were used for the analyses.

## Results

### *Sunburn*

The characteristics of the study population are presented in Table I. Sunburn was experienced at least once by 1,222 persons (35%), with no gender difference. Sunburn became less frequent with age, with skin type and with an educational level above primary or lower secondary school. However, in the logistic regression analysis including age and skin type, the difference in education is not significant.

Persons who had been sunburnt during the previous summer had been exposed in the garden (34%), on the beach (35%) or on vacations in sunny resorts (25%); 80% of persons who experienced sunburn in 2007 had also experienced sunburn during childhood.

### *Basic use of protective measures*

Sunscreens were used by 82% of women and 59% of men ( $\chi^2$ , 215.22, 1 df,  $p < 0.0001$ ). More women than men frequently sought shade as a protective measure (48% vs. 42%,  $\chi^2$ , 11.19, 1 df,  $p = 0.0008$ ), while more men than women used a sunhat (34% vs. 21%,  $\chi^2$ , 78.29, 1 df,  $p < 0.0001$ ) and light clothing (65% vs. 54%,  $\chi^2$ , 40.99, 1 df,  $p < 0.0001$ ) during peak UVR hours.

### *Sunburn and sun protection*

The prevalence of sunburn was lower among frequent users of light clothing and shade as protective measures (Table II), while wearing a sunhat was not associated with sunburn. A larger fraction of frequent sunscreen users than non-users and infrequent users combined were sunburnt. In a logistic regression analysis including gender, age, education, skin type and (other) protective measure as confounders, we found that use of shade and light clothing were negatively associated (i.e. were protective) with

Table I. Characteristics of all persons and of those experiencing at least one episode of sunburn during the past summer in a "sun survey" in Denmark, August 2007.

Category	All ( <i>n</i> = 3,499)		Sunburnt ( <i>n</i> = 1,222)		OR (95% CI) for being sunburnt	
	%	<i>n</i>	%	<i>n</i>	Crude	Adjusted <sup>a</sup>
Sex					<i>p</i> = 0.130	
Women	59	2,054	36	739	1 (reference)	
Men	41	1,445	34	483	0.90 (0.78–1.03)	
Age group (years)					<i>p</i> < 0.001	<i>p</i> < 0.001
15–19	9	320	54	171	4.21 (3.20–5.55)	4.44 (3.34–5.90)
20–29	12	427	50	213	3.62 (2.82–4.66)	3.50 (2.71–4.53)
30–39	26	897	37	333	2.14 (1.73–2.66)	1.97 (1.59–2.45)
40–49	29	1,018	32	325	1.70 (1.38–2.10)	1.58 (1.28–1.96)
50–59	24	837	22	180	1 (reference)	1 (reference)
Education					<i>p</i> < 0.001	<i>p</i> = 0.520
Primary or lower secondary	15	537	44	234	1.54 (1.21–1.96)	1.23 (0.89–1.70)
Upper secondary	29	997	35	350	1.08 (0.87–1.33)	1.07 (0.86–1.33)
Skilled/short	38	1,327	32	422	0.93 (0.76–1.14)	1.00 (0.81–1.23)
University	18	621	34	208	1 (reference)	1 (reference)
Skin type					<i>p</i> < 0.001	<i>p</i> < 0.001
I	11	390	16	192	2.72 (2.18–3.52)	2.57 (2.01–3.29)
II	53	1,839	59	721	1.85 (1.57–2.17)	1.83 (1.55–2.16)
III	33	1,146	24	297	1 (reference)	1 (reference)
IV	3	85	1	12	0.47 (0.25–0.88)	0.35 (0.18–0.66)

Sunburning became less frequent with age, with skin type and with an educational level above primary or lower secondary school. *p*-values are tests for variation between factor levels. <sup>a</sup>The model included age, education and skin type.

Table II. Logistic regression analysis of sun protection measures and risk variables for sunburn in a survey in Denmark, August 2007.

Sun protection	Sunburnt versus not sunburnt <sup>a</sup>		
	<i>n</i>	Yes (%)	OR (95% CI)
Shade	3,485		<i>p</i> < 0.001
Yes	1,590	30	0.7 (0.6–0.8)
No	1,895	39	1.0 (reference)
Sunhat	3,485		<i>p</i> = 0.169
Yes	923	34	1.1 (0.9–1.3)
No	2,562	35	1.0 (reference)
Light clothing	3,485		<i>p</i> < 0.001
Yes	2,032	31	0.7 (0.5–0.8)
No	1,453	41	1.0 (reference)
Sunscreen	3,485		<i>p</i> < 0.001
Yes	2,526	38	1.4 (1.2–1.6)
No	959	27	1.0 (reference)

*p* values are for test for variation among factor levels. <sup>a</sup>The model included gender, age, education, skin type and the four sun protective measures.

sunburn, while sunscreen use was positively associated (Table II). The more protective measures, shade or light clothing, the participants used, the lower their risk for sunburn ( $\chi^2$ , 53.10, 2 df, *p* < 0.0001); 43% of persons not using shade or light clothing and only 28% of those using both protective measures experienced sunburn.

### Intentional tanning

Intentional tanners constituted 15% of the respondents in our sample, i.e. they used every opportunity to sunbathe. Women were more often intentional tanners than men (20% vs. 8%,  $\chi^2$ , 87.83, 1 df, *p* < 0.0001); persons aged 15–19 were more often intentional tanners than older groups (28% vs. 12–17%,  $\chi^2$ , 51.48, 3 df, *p* < 0.0001); and a gradient for intentional tanning was found with educational level, the lowest level having the highest proportion of intentional tanners (21% for persons with only primary or lower education vs. 10% for people with education at university level,  $\chi^2$ , 28.89, 3 df, *p* < 0.0001).

### Intentional tanning, sunburn and sunscreen

The OR for sunburn of intentional tanners was 1.6 (95% CI, 1.3–2.0; *p* < 0.0001), 45% of intentional tanners and 33% of unintentional tanners being sunburnt ( $\chi^2$ , 24.31, 1 df, *p* < 0.0001), and intentional tanners used sunscreen more often than unintentional tanners (77% vs. 72%,  $\chi^2$ , 7.82, 1 df, *p* = 0.005). The difference in sunscreen use between intentional tanners who became sunburnt (79%) and those who did not (76%) was not statistically significant ( $\chi^2$ , 0.93, 1 df, *p* = 0.34). A larger fraction of

unintentional tanners with sunburn, however, used sunscreen than those who did not get sunburnt (78% vs. 68%,  $\chi^2$ , 33.32, 1 df,  $p < 0.0001$ ).

#### *Use of sunscreen to prolong time in the sun*

Sunscreen had been used to prolong the time spent in the sun by 66% of persons who had suffered sunburn in the past 12 months ( $\chi^2$ , 12.29, 2 df,  $p = 0.002$ ). Among intentional tanners, 68% used sunscreen to prolong the time spent in the sun ( $\chi^2$ , 9.34, 2 df,  $p = 0.009$ ).

#### *Duration of sun exposure, intentional tanning and sunscreen use*

Unintentional tanners who used sunscreen spent less time in the sun than those who did not use sunscreen ( $\chi^2$ , 26.57, 5 df,  $p < 0.0001$ ). A similar difference was not found for intentional tanners ( $\chi^2$ , 10.41, 5 df,  $p = 0.0643$ ). No association was found between sunscreen use and time spent in the sun by logistic regression analysis including gender, age, education and skin type, among either intentional or unintentional tanners.

## **Discussion**

We found that persons who used light clothing or shade as protective measures in peak UVR hours had fewer episodes of sunburn than non-users, and sunscreen users had more sunburn than non-users. More intentional tanners than unintentional tanners were sunburnt and used sunscreen. There was no difference in sunscreen use between sunburnt and not sunburnt intentional tanners; however, among unintentional tanners, use of sunscreen was more prevalent among sunburnt persons.

It is alarming if the association between use of sunscreen and the risk for being sunburnt is causal, i.e. if use of sunscreen increases the risk for being sunburnt when applied in order to extend the time spent in the sun. Previously reported reasons for a positive association between sunscreen and sunburn included incorrect application, lack of reapplication and extension of the time spent in the sun [8–10]. Thieden et al. [11] reported that sunscreen use was associated with risky behaviour (exposing the shoulders and upper body) and that sunscreens were used as tanning aids to avoid sunburn. Nevertheless, sunburn occurred twice as often when sunscreen was used. After adjustment for the protective effects of sunscreen, sunscreen users still had higher or equal

exposure to UVR than persons who did not apply sunscreen due to differences in their behaviour. Autier et al. [6] concluded that sunscreen was used to increase time in the sun by intentional tanners but not by unintentional tanners. In this study, we found no difference in the time spent in the sun by intentional and unintentional tanners according to sunscreen use, despite the fact that two thirds of intentional tanners used sunscreen to prolong time in the sun. We also found no effect of sunscreen on the prevention of sunburn in either group.

The commonest situations in which sunburn occurred in this study were “the beach”, “on sunny vacations” and “the garden”. Each is related to intentional exposure, although “the garden” is also related to unintentional sun exposure. The largest difference in sunburn among subgroups that we found was with age (OR 4.44; 15–19 vs. 50–59), emphasizing the need to educate young people on sun behaviour to reduce their lifetime sunburn history.

#### *Strengths and limitations of the study*

We could not compare our study with previous reports of the sun-related behaviour of the Danish population, as the wording and the intervals used in the surveys were different. Although a larger fraction (59%) of the participants in the survey than in the Danish population were women (50%), this would not affect the prevalence of sunburn, as no gender difference was found. As risk of sunburn decreases with age, the exclusion of age group 60+ is a limitation that affects the results positively, when generalizing to the Danish population. Skin type was self assessed. The low response rate in the telephone interviews was due to failure to reach a large percentage, but the response rate was acceptable for a web panel [12]. Selection bias might have occurred if intentional tanners were less (or more) likely to participate in the survey.

## **Conclusions**

We found that 35% of the participants had been sunburnt within the past 12 months; negative associations with shade and light clothing; a positive association with use of sunscreen; and 66% of the participants used sunscreen to prolong their time in the sun. Sunburn became less frequent with age and skin type.

We suggest that sun protection campaigns and initiatives consider the following points in future communications:

- Shade and protective clothing are the most efficient means of protecting against sunburn and consequently skin cancer.
- Sunscreen use is associated with sunburn and prolonging the time in the sun.
- There is a strong risk associated with intentional tanning.

Young people especially should be targeted as they experience most sunburn and are of major preventive potential.

### Acknowledgments

The survey was funded by the Tryg Foundation. The data were collected by Epinion.

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