



Association between sunburn and demographic factors and health behaviour among Danish students

Maria Kristine Hagelskær Meyer^{a,*}, Anne Sofie Plum Christensen^a, Janne Schurmann Tolstrup^b, Peter Dalum^a, Brian Køster^a

^a Danish SunSmart Campaign, Danish Cancer Society, Copenhagen, Denmark

^b National Institute of Public Health, Copenhagen, Denmark

ARTICLE INFO

Keywords:

Sunburn
Skin cancer
Cancer prevention
Students
Health behaviour
Danish national youth study

ABSTRACT

Sunburn is associated with an increased risk for skin cancer. Denmark has one of the highest incidences of melanoma in the world, although it is a relatively northern country. The objective of this study was to determine whether sunburn is associated with demographic factors and health behaviour among young Danes. Cross-sectional data of > 55,000 15- to 25-year-old students participating in the Danish National Youth Study were collected in 2014. Multilevel logistic regression analysis was used to determine associations. Overall, 45% of the students had experienced at least one sunburn in Denmark, and 60% had experienced one sunburn abroad in the past year. Females had higher odds for sunburns than males. Education and geographical region were associated with sunburn but with opposite trends related for sunburn experienced in Denmark and abroad. Students who had poor dietary habits (only abroad), indulged in binge-drinking, smoked (only in Denmark), and more physical activity (only abroad) had higher odds for having a sunburns. We conclude that sunburn is prevalent among young Danes, especially those travelling abroad. Although we found some associations with demographic factors and health behaviour, there were no evident tendencies, thus indicating that broad population-based campaigning should be the preferred intervention.

1. Introduction

The incidence of skin cancer has increased globally during the past few decades, with 2–3 million cases of nonmelanoma skin cancer and 132,000 cases of melanoma annually (WHO, 2017). Exposure to ultraviolet radiation from the sun and from sunbeds is the main cause of skin cancer (Armstrong and Kricger, 1993; Boniol et al., 2012; Ghassassi et al., 2009). Sunburn at any age and due to lifetime exposure are both associated with an increased risk for skin cancer (Dennis et al., 2008; Elwood and Jopson, 1997; Veierod et al., 2003; Wu et al., 2016). Denmark has one of the highest skin cancer incidences in the world (Ferlay et al., 2013), although the country is located far from the equator (56°N) and thus has lesser ultraviolet radiation than countries located closer to the equator. Melanoma is the most common type of cancer among Danish females aged 15–34 years and the third most common type of cancer among men in that age range (Engholm et al., 2015).

Sunburn is common and associated with characteristics such as young age (Buller et al., 2011; Green et al., 2013; Hall et al., 2003;

Holman et al., 2014), male sex (Buller et al., 2011; Coups et al., 2008; Green et al., 2013; Hall et al., 2003; Holman et al., 2014), white race (Buller et al., 2011; Coups et al., 2008; Green et al., 2013; Hall et al., 2003) and light skin type (Hall et al., 2003; Holman et al., 2014). In addition, sunburn has been associated with health behaviour such as smoking, alcohol consumption and physical activity, although the associations were inconsistent (Buller et al., 2011; Coups et al., 2008; Green et al., 2013; Hall et al., 2003; Holman et al., 2014). The majority of previous studies were conducted in Australia or the USA. In view of the cultural and meteorological differences between those countries and Europe and the inconsistency of the results of previous research, more information is required about the factors related to sunburns in the European context.

The Danish Sun Safety Campaign has existed since 2007 and has conducted annually campaigns to make Danes more aware of the risk of sunburns and educate them in protecting themselves from the sun (Kræftens Bekæmpelse og TrygFondens Solkampagne). Identification of the characteristics of Danes who experience sunburn would maximise the effectiveness of preventive strategies and campaigns. The objective

* Corresponding author: Danish SunSmart Campaign, Department of Prevention and Information, Danish Cancer Society, Strandboulevarden 49, DK-2100 Copenhagen, Denmark.

E-mail address: marmey@cancer.dk (M.K.H. Meyer).

<https://doi.org/10.1016/j.ypmed.2018.08.009>

Received 15 February 2018; Received in revised form 29 June 2018; Accepted 7 August 2018

Available online 18 October 2018

0091-7435/© 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

of this study was to determine whether sunburn is associated with demographic characteristics and health behaviour (diet, smoking, alcohol consumption and physical activity) among young Danes.

2. Methods

2.1. Design and participants

The Danish National Youth Study survey was conducted by the National Institute of Public Health in 2014. The survey consisted of > 250 questions on health behaviours, health and well-being and was administered in class with a teacher present (Pisinger et al., 2017). All 137 Danish upper secondary schools and higher preparatory examination schools were invited (except those for the international baccalaureate). Upper secondary school provides 3 years of education to prepare students for higher education such as university. Higher preparatory examination schools are similar to upper secondary schools, but the programme is only 2 years long, and they are generally attended by older students. Additionally, 12 of the largest vocational colleges in Denmark were invited to participate, with selected classes from the basic programme. The 89 vocational colleges in Denmark prepare students for a wide range of jobs such as carpentry, cooking or hairdressing.

In total, 75,853 students answered the questionnaire. The analyses were restricted to students aged 15–25 years ($n = 75,022$), and we excluded those for whom data were missing on education ($n = 1849$), parental education (2843), dietary habits ($n = 1890$), smoking ($n = 48$), binge-drinking ($n = 290$) and physical activity ($n = 879$). Students who did not answer the question about sunburn in Denmark ($n = 3232$) were excluded from the relevant analyses. Students who had not been on a holiday abroad in the past year and therefore did not answer the question on sunburn abroad were excluded from the relevant analyses ($n = 9292$). Both questions were answered by 62,429 students. The final study population comprised 63,991 students for the analysis on sunburn in Denmark and 57,931 for the analysis on sunburn abroad (84% and 76% of the original data set, respectively). The selection of the study population is shown in Fig. 1.

2.2. Study measures

2.2.1. Outcome measure

The study outcome, sunburn, was measured from answers to the question ‘Within the last year, how many times have you had a sunburn?’ Sunburn was defined as any redness, discomfort, pain or blisters on the skin lasting longer than 12 h. The students could answer this question in correlation with sunburns that occurred in Denmark and abroad (only for students who previously had sunburns said that they had been on a sunny holiday abroad). The outcome was dichotomised into *sunburn* (had one or more sunburn the past year) or *not-sunburn* (did not have a sunburn in the past year). The proportions of sunburn in the different response categories are listed in Table 1.

2.2.2. Demographic characteristics

The demographic factors included in this study were sex, age (15, 16, 17, 18, 19 and 20–25 years), educational level of the students (upper secondary school, higher preparatory examination school and vocational college) and geographical region of Denmark (Capital, Zealand, Southern, Central and North). We also included the highest education of the students’ parents (from Statistics Denmark) as a predictor of the student’s socioeconomic status, in the following categories: primary school, vocational college, upper secondary school, higher education ≤ 2 years, higher education 3–4 years and higher education > 4 years.

2.2.3. Health behaviour

We assessed dietary habits, smoking, binge-drinking and physical activity. Dietary habits were assessed from an index constructed from answers on eating habits in a normal week: eating fruit daily (yes, 1; no: 0); eating vegetables daily (yes, 1; no: 0) and eating wholemeal products (e.g. oats and wholemeal pasta) daily (yes, 1; no: 0). These responses were summed and scored between 0 and 3, with 0 as ‘poor habits’, 1 as ‘fair habits’, 2 as ‘good habits’ and 3 as ‘excellent habits’. Smoking was identified from answers to the question ‘Which statement describes you best?’, with the following possible response categories: I smoke daily, I smoke at least once a week, I smoke sometimes (e.g. at parties), I rarely smoke and I never smoke. Binge-drinking was assessed from answers to the question ‘Within the past 30 days, how many times

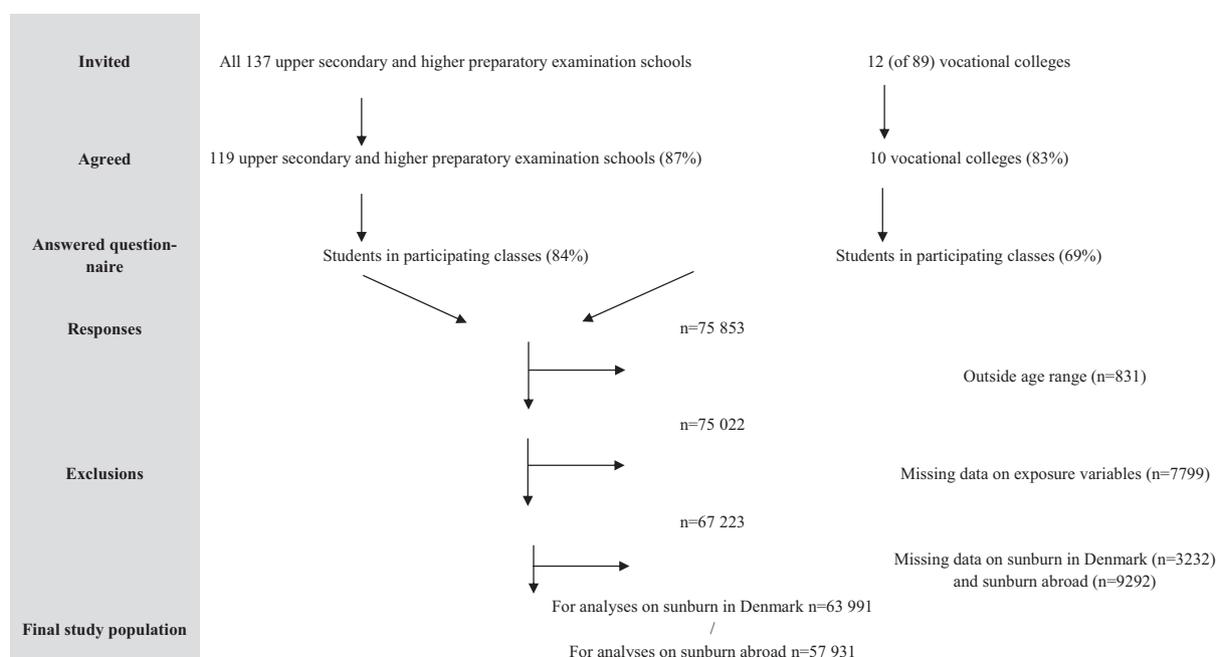


Fig. 1. Selection of the study population.

Table 1

Characteristics of the Danish Youth Study population used in the analysis of sunburn in Denmark ($n = 63,991$) and of sunburn abroad (57931) according to the study variables and proportions of sunburn in both analyses among students aged 15–25 years in 2014.

Variable	Sunburn in Denmark <i>n</i> (%)		% sunburn ^a	Sunburn abroad <i>n</i> (%)		% sunburn ^a
Total	63,991	(100)	45.2	57,931	(100)	59.8
Sunburn (no.)						
0	35,044	(54.8)		23,318	(40.3)	
1–2	22,790	(35.6)		26,495	(45.7)	
3–5	4468	(7.0)		5839	(10.1)	
> 5	1689	(2.6)		2279	(3.9)	
Sex						
Females	38,325	(59.9)	47.9	34,489	(59.5)	62.2
Males	25,666	(40.1)	41.2	23,442	(40.5)	56.1
Age (years)						
15	1306	(2.0)	40.5	1194	(2.1)	57.9
16	12,327	(19.3)	40.4	11,370	(19.6)	60.0
17	21,257	(33.2)	45.5	19,154	(33.1)	59.9
18	18,622	(19.1)	46.9	16,837	(29.1)	60.7
19	8343	(13.0)	48.5	7556	(13.0)	61.4
≥ 20	2142	(3.4)	46.5	1820	(3.1)	41.9
Education						
Upper secondary	56,488	(88.3)	45.0	51,489	(88.9)	61.0
Higher preparatory examination	4347	(6.8)	46.8	3750	(6.5)	54.2
Vocational college	3156	(4.9)	46.9	2692	(4.7)	43.8
Geographical region of Denmark						
Capital	19,521	(30.5)	40.7	18,430	(31.8)	61.5
Zealand	9943	(15.5)	48.5	8689	(15.0)	56.7
Southern	13,380	(20.9)	46.7	11,877	(20.5)	57.4
Central	13,789	(21.6)	46.1	12,457	(21.5)	61.9
Northern	7358	(11.5)	48.4	6487	(11.2)	59.0
Highest parental education						
Primary school	2919	(4.6)	39.2	2525	(4.4)	43.5
Vocational college	21,065	(32.9)	45.9	18,549	(32.0)	57.8
Upper secondary school	1667	(2.6)	36.3	1496	(2.6)	51.9
Higher education (≤ 2 y)	4560	(7.1)	43.9	4115	(7.1)	60.6
Higher education (3–4 y)	20,045	(31.3)	47.0	18,171	(31.4)	61.7
Higher education (< 4 y)	13,735	(21.5)	44.4	13,075	(22.6)	63.6
Dietary habits						
0 – Poor	19,709	(30.8)	43.4	17,644	(30.5)	56.1
1 – Fair	17,291	(27.0)	46.1	15,521	(26.8)	59.0
2 – Good	14,064	(22.0)	45.7	12,827	(22.1)	61.9
3 – Excellent	12,927	(20.2)	46.4	11,939	(20.2)	63.9
Smoking						
Never	34,662	(54.2)	45.8	31,223	(53.9)	55.7
Rarely	7445	(11.6)	47.5	6842	(11.8)	63.7
Sometimes	11,292	(17.7)	49.5	10,274	(17.7)	64.5
At least once a week	2569	(4.0)	49.1	2361	(4.1)	62.4
Daily	8023	(12.5)	42.7	7231	(12.5)	58.3
Binge-drinking (times in past 30 days)						
0	13,727	(21.5)	35.8	12,142	(21.0)	58.9
1	10,853	(17.0)	45.9	9721	(16.8)	57.9
2	11,994	(18.7)	47.2	10,837	(18.7)	62.4
3–4	16,442	(25.7)	49.2	15,113	(26.1)	64.5
≥ 5	10,975	(17.2)	48.4	10,118	(17.5)	64.9
Physical activity (duration normal week)						
None	5421	(8.5)	41.5	4622	(8.0)	48.7
30–60 min	13,666	(21.4)	46.3	12,164	(21.0)	57.0
2–3 h	19,427	(30.4)	46.6	17,651	(30.5)	61.3
4–6 h	15,306	(12.8)	45.5	14,010	(24.2)	62.3
≥ 7 h	10,171	(15.9)	42.8	9484	(16.4)	62.0

^a χ^2 test was conducted for all variables to assess for differences in sunburn in Denmark and abroad. All parameters showed a statistically significant difference ($p < 0.05$).

have you consumed five or more drinks on one occasion?', and the answers were categorised as 0, 1, 2, 3–4 and ≥ 5 . Physical activity was assessed from answers to the question 'Outside school, how many hours a week do you usually exercise to the extent that you become breathless or sweat?'. The answers were categorised as None, 30–60 min, 2–3 h, 4–6 h and ≥ 7 h.

2.3. Statistical analyses

The statistical package STATA/IC11.1 was used for all statistical

analyses. Multilevel logistic regression models were used to examine the associations between sunburn, demographic factors and health behaviour. The selected variables were identified from literature or based on a priori knowledge.

Table 1 shows differences between students who had sunburns and those who did not have, assessed with the χ^2 test. For the multilevel logistic regression models (Table 2), we report odds ratios (ORs) and their 95% confidence interval [95% CI]. Tests for trend were conducted for relevant variables to assess whether there was a trend in the proportions over the exposure categories and where p -values < 0.05 were

Table 2
Odds ratios for sunburn^a in Denmark and abroad by demographic characteristics and health behaviour of Danish students aged 15–25 years in 2014.

Variable	Analysis of sunburn in Denmark (n = 63,991)			Analysis of sunburn abroad (n = 57,931)		
	Unadjusted OR [95% CI]	Adjusted OR ^c [95% CI]	p-Value ^b	Unadjusted OR [95% CI]	Adjusted OR ^c [95% CI]	p-Value ^b
Sex						
Male	Ref	Ref	–	Ref	Ref	–
Female	1.3 [1.3–1.4]	1.3 [1.3–1.4]		1.3 [1.2–1.3]	1.3 [1.2–1.3]	
Age (years) ^b						
15	0.8 [0.7–0.9]	0.8 [0.7–0.9]	< 0.000	0.9 [0.8–1.0]	0.9 [0.8–1.0]	< 0.000 ^d
16	0.8 [0.8–0.9]	0.8 [0.8–0.9]		1.0 [0.9–1.0]	1.0 [0.9–1.0]	
17	Ref	Ref		Ref	Ref	
18	1.1 [1.0–1.1]	1.1 [1.0–1.1]		1.0 [1.0–1.1]	1.0 [1.0–1.1]	
19	1.1 [1.1–1.2]	1.1 [1.1–1.2]		1.1 [1.0–1.1]	1.1 [1.0–1.2]	
20 or older	1.0 [0.9–1.1]	1.1 [1.0–1.2]		0.6 [0.5–0.6]	0.7 [0.6–0.8]	
Education						
Upper secondary	Ref	Ref	–	Ref	Ref	–
Higher preparatory examination	1.0 [1.0–1.1]	1.0 [0.9–1.1]		0.8 [0.7–0.8]	0.9 [0.8–0.9]	
Vocational	1.1 [0.9–1.3]	1.2 [1.1–1.4]		0.5 [0.4–0.6]	0.7 [0.6–0.8]	
Geographic region of Denmark						
Capital	Ref	Ref	–	Ref	Ref	–
Zealand	1.4 [1.2–1.5]	1.3 [1.2–1.5]		0.8 [0.7–0.9]	0.8 [0.7–0.9]	
Southern	1.3 [1.2–1.4]	1.3 [1.2–1.4]		0.9 [0.8–1.0]	0.8 [0.8–0.9]	
Central	1.3 [1.2–1.4]	1.2 [1.1–1.4]		1.0 [0.9–1.1]	1.0 [0.9–1.1]	
Northern	1.4 [1.3–1.6]	1.4 [1.2–1.5]		0.9 [0.8–1.1]	0.9 [0.8–1.1]	
Highest parental education ^b						
Primary school	0.8 [0.7–0.8]	0.7 [0.7–0.8]	< 0.000 ^d	0.5 [0.5–0.6]	0.5 [0.5–0.6]	< 0.000
Vocational college	1.0 [1.0–1.0]	0.9 [0.9–1.0]		0.9 [0.8–0.9]	0.9 [0.8–0.9]	
Upper secondary school	0.7 [0.6–0.8]	0.7 [0.6–0.8]		0.7 [0.6–0.7]	0.6 [0.6–0.7]	
Higher education (≤ 2 y)	0.9 [0.9–1.0]	0.9 [0.8–1.0]		0.9 [0.9–1.0]	0.9 [0.9–1.0]	
Higher education (3–4 y)	1.1 [1.0–1.1]	1.0 [1.0–1.1]		1.0 [0.9–1.0]	1.0 [0.9–1.0]	
Higher education (< 4 y)	Ref	Ref		Ref	Ref	
Dietary habits ^b						
0 – Poor	0.9 [0.8–0.9]	0.9 [0.9–1.0]	< 0.000 ^d	0.8 [0.7–0.8]	0.8 [0.8–0.9]	< 0.000
1 – Fair	1.0 [0.9–1.0]	1.0 [1.0–1.1]		0.8 [0.8–0.9]	0.9 [0.8–0.9]	
2 – Good	1.0 [0.9–1.0]	1.0 [0.9–1.0]		0.9 [0.9–1.0]	0.9 [0.9–1.0]	
3 – Excellent	Ref	Ref		Ref	Ref	
Smoking ^b						
Never	Ref	Ref	< 0.000	Ref	Ref	< 0.000 ^d
Rarely	1.3 [1.2–1.4]	1.1 [1.1–1.2]		1.2 [1.1–1.2]	1.1 [1.1–1.2]	
Sometimes	1.3 [1.2–1.4]	1.2 [1.1–1.3]		1.3 [1.2–1.4]	1.3 [1.2–1.3]	
At least once a week	1.2 [1.1–1.3]	1.3 [1.2–1.3]		1.2 [1.1–1.3]	1.2 [1.1–1.3]	
Every day	1.1 [1.1–1.2]	1.3 [1.2–1.3]		0.9 [0.9–1.0]	1.0 [0.9–1.0]	
Binge-drinking (times in past 30 days) ^b						
0	Ref	Ref	< 0.000	Ref	Ref	< 0.000
1	1.5 [1.4–1.6]	1.5 [1.4–1.5]		1.4 [1.3–1.5]	1.4 [1.3–1.4]	
2	1.6 [1.5–1.7]	1.5 [1.5–1.6]		1.7 [1.6–1.8]	1.6 [1.5–1.7]	
3–4	1.7 [1.7–1.8]	1.7 [1.6–1.8]		1.8 [1.7–1.9]	1.8 [1.7–1.9]	
≥ 5	1.7 [1.6–1.8]	1.8 [1.7–1.8]		1.8 [1.7–1.9]	1.8 [1.7–1.9]	
Duration of exercise ^b						
None	Ref	Ref	< 0.000 ^d	Ref	Ref	< 0.000
30–60 min.	1.2 [1.1–1.3]	1.2 [1.1–1.3]		1.3 [1.3–1.4]	1.3 [1.2–1.4]	
2–3 h	1.2 [1.2–1.3]	1.2 [1.1–1.3]		1.6 [1.5–1.7]	1.6 [1.5–1.7]	
4–6 h	1.2 [1.1–1.3]	1.2 [1.1–1.3]		1.7 [1.6–1.8]	1.7 [1.6–1.8]	
≥ 7 h	1.1 [1.0–1.2]	1.2 [1.1–1.2]		1.6 [1.5–1.8]	1.7 [1.6–1.9]	

^a Defined as have been sunburnt at least once in Denmark or abroad within the past year.

^b A test for trend was conducted only where relevant.

^c Variables were adjusted for demographic factors.

^d Test for trend were statistical significant, but with an OR: 1.0 [1.0–1.0].

considered statistically significant. As the respondents were not independent (e.g. students attending the same school might be more similar than students attending different schools), we included school as a random effect in all logistic regression models. Each school was given a unique identification number, which was used as the cluster level.

In sensitivity analyses, individuals for whom information about exposure was missing were included by creating a ‘no information’ group for each variable (n = 69,549) to assess whether the estimates were similar to those of our two main analyses, from which these individuals were excluded. The estimates did not differ considerably.

3. Results

3.1. Study population

Of the students, 60% were females, and the majority (95%) were aged 16–19 years and studied at an upper secondary school (88–89%). The highest education of the students' parents was primarily in a vocational college (32–33%) or higher education for > 3 years (53–54%).

The study population differed only with regard to the number of sunburns (Table 1). Of the students who had experienced at least one sunburn in the past 12 months, 45% had done so in Denmark and 60% abroad. Sunburn was more prevalent among females (Denmark: 48%, abroad: 62%) than males (41% and 56%, respectively) (Table 1).

Table 2 shows the unadjusted and adjusted odds for having a sunburn in Denmark and abroad according to demographic and health behaviour.

3.2. Analysis of sunburn in Denmark

Females had higher odds of sunburns than males (OR = 1.4 [1.3–1.4]). Students attending a vocational college had higher odds for sunburn than those attending an upper secondary school (OR = 1.2 [1.1–1.4]), but only in the adjusted analysis. Living in any region other than the Capital region was associated with a higher odds of sunburn in Denmark (e.g. OR = 1.3 [1.2–1.5]; Zealand vs Capital region). The odds for sunburn in Denmark tended to slightly increase with age. The odds for sunburn were inconsistent according to different parental education categories, but students whose parental education was primary school or upper secondary school had significantly lower odds than those whose parents had had ≥ 4 years of education. With regard to health behaviour, sunburn was associated mainly with being a smoker (OR = 1.3 [1.2–1.3]; smoking daily vs never) and a binge-drinker once or more in the past 30 days (OR = 1.7 [1.6–1.8]; binge-drinking 3–4 times a month vs zero times). There was no clear association between dietary habits and physical activity and sunburn in Denmark.

3.3. Analysis of sunburns abroad

Table 2 shows that females also had higher odds for sunburns than males (OR = 1.3 [1.2–1.3]). Students attending a vocational college had lower odds for sunburn than those attending an upper secondary school (OR = 0.7 [0.6–0.8]), and living in any region other than the Capital region was associated with lower odds for sunburn abroad (e.g. OR = 0.8 [0.8–0.9]; Southern region vs Capital region). Students whose parents had had less than higher education of ≥ 4 years had lower odds for sunburn (OR = 0.5 [0.5–0.6]; primary school vs higher education ≥ 4 years). There was no clear trend in the association between age and sunburn abroad.

Poor dietary habits were associated with lower odds for sunburn (OR 0.8 [0.8–0.9]; poor habits vs excellent habits), binge-drinking often (OR = 1.8 [1.7–1.9]; binge-drinking 3–4 times a month vs zero times) and having a high physical activity level (OR = 1.5 [1.4–1.6]; 4–6 h a week vs no physical activity) were associated with sunburns abroad. There was no clear association between smoking and sunburns abroad.

4. Discussion

In this study, 45% of the students had experienced sunburn in Denmark and 60% had experienced a sunburn abroad in the previous year, with more females than males having had a sunburn. The odds for sunburn were lower when the parents' education had been low. For sunburn in Denmark, students attending a vocational college had higher odds of sunburn than those attending an upper secondary school; this association was reversed for sunburn abroad. Students who had poor dietary habits had lower odds for sunburn than students with excellent habits (only abroad). Students who smoked had higher odds for sunburn than never smokers (only in Denmark), and students who indulged in binge-drinking had higher odds of having sunburn (Denmark and abroad). Students with high physical activity had high odds of sunburn (only abroad).

Our finding that females were more likely than males to experience sunburn in Denmark and abroad is in contrast to those of most other studies (Buller et al., 2011; Green et al., 2013; Hall et al., 2003) and one study that found no statistical significant difference between the sexes (Holman et al., 2014). Either Danish women sunbathe more often than women in other countries or perhaps Danish men tend to forget sunburn more easily or pay less attention to sunburn than Danish women. Previous research addressed primarily and found that the youngest age group was the most likely to experience sunburn (Buller et al., 2011; Green et al., 2013; Hall et al., 2003; Holman et al., 2014). We found no

clear association between age and sunburn probably because of the narrow age range (15–25 years). Other studies found that higher education was associated with higher odds (Holman et al., 2014) or found no association with sunburn (Hall et al., 2003). Some studies have found different odds for sunburn between different regions of countries (Hall et al., 2003; Holman et al., 2014). In the present study, the associations between education, geographical region and sunburn depended on whether the sunburn occurred in Denmark or abroad. As Denmark is a small country, a person's exposure to ultraviolet radiation should not differ by region. The difference might be explained by social and educational level, as a higher proportion of highly educated citizens live in the Capital region than in the other regions (Statistics Denmark, 2015). Our finding that students whose parents had had lower education had lower odds for sunburn abroad might be due to differences in parents' income. Even though the odds are adjusted for parental education, there might still be some differences in how and where the student goes on a holiday. Students with wealthier parents might take longer holidays to more exotic countries with a higher ultraviolet index than students whose parents are less wealthy. Comparison with previous research suggests that associations between demographic factors and sunburn vary widely by study populations, and no definite conclusion can be reached.

Green et al. found no association between fruit intake and sunburn (Green et al., 2013). We also found no association with dietary habits, although we looked wider than just fruit intake. Three studies found no association between smoking and sunburn (Green et al., 2013; Hall et al., 2003; Holman et al., 2014), similar to our results for sunburn abroad but different from our results for sunburn in Denmark, for which we did find an association. Two studies examining the association between alcohol drinking and sunburn found that current alcohol drinkers (Holman et al., 2014) and excessive alcohol consumption (Hall et al., 2003) were association with higher odds of sunburn. This is in agreement with our findings that binge-drinking once a month or more was associated with higher odds for sunburn, both in Denmark and in abroad. These associations imply that some young Danes engage in risky health behaviour, perhaps including sunbathing. Others (Green et al., 2013; Hall et al., 2003; Holman et al., 2014) have found that a higher level of physical activity is associated with higher odds for sunburn, as we found for sunburn abroad. People who are physically active might participate more in outdoor activities while abroad; however, we found no association between physical activity and sunburn in Denmark, which we should have observed if this assumption was true.

We thus found associations between sunburn and dietary habits (only abroad), binge-drinking, smoking (only in Denmark) and physical activity (only abroad). Unlike some other studies, we examined sunburn in Denmark and abroad separately; however, the different associations found make it difficult to arrive at an overall conclusion. Despite our large study sample, we found few clear associations between sunburn, demographic factors and health behaviour. This indicates that sunburn is a widespread phenomenon among young Danes and is not limited to certain demographic groups or people with certain health behaviour. Therefore, preventive campaigns and strategies should address the whole population and not only on small risk groups.

4.1. Study limitations and strengths

Our study had a high response rate and a large study sample comprising > 7% of all 15- to 25-year-old Danes in 2014. The sample can be considered representative of Danish students aged 15–25 years who are attending an upper secondary school or a higher preparatory examination school and can be considered representative to some degree for students attending vocational college; thus, this group were more selected in the invitations to the study. The sample is not, however, representative of all Danish people aged 15–25 years, as it does not include those in other types of educational establishment and outside

the educational system. The findings are not necessarily applicable to other countries, as Danes are more affluent than many other nationalities. One limitation is that we had no information about skin type, which is an important predictor for sunburn (Diepgen and Mahler, 2002). We also had no information about where the students went on a vacation and for how long. This would have been useful, as the longer a person is on a sunny holiday and the closer to the equator, the higher is the likelihood of sunburn. We relied on self-reported data with no objective verification, and this would have resulted in information bias if students intentionally or unintentionally answered the questions incorrectly.

5. Conclusion

Sunburn is an important, easily preventable risk factor for skin cancer. The results from this study show that sunburn is common among Danish students, especially among females and in students who travel abroad. As Denmark has one of the highest prevalence of skin cancers in the world, prevention is crucial. Our results indicate that broad population-based campaigning should be the preferred intervention. More information about what motivates young Danes to engage in safer sun behaviour is needed to make preventive campaign and strategies more efficient and effective.

Acknowledgments

The Danish SunSmart Campaign is supported financially by the philanthropic foundation TrygFonden. This study was supported financially by TrygFonden, the Danish Cancer Society and the 'Crown Prince Frederik's and Crown Princess Mary's Foundation'.

Data were collected by the National Institute of Public Health, University of Southern Denmark.

Conflicts of interest

The authors have no conflicts of interest.

References

- Armstrong, B.K., Kricger, A., 1993. How much melanoma is caused by sun exposure? *Melanoma Res.* 3, 395–401.
- Boniol, M., Autier, P., Boyle, P., Gandini, S., 2012. Cutaneous melanoma attributable to sunbed use: systematic review and meta-analysis. *BMJ* 345, e4757.
- Buller, D.B., Cokkinides, V., Hall, H.I., Hartman, A.M., Saraiya, M., Miller, E., Paddock, L., Glanz, K., 2011. Prevalence of sunburn, sun protection, and indoor tanning behaviors among Americans: review from national surveys and case studies of 3 states. *J. Am. Acad. Dermatol.* 65, S114–S123.
- Coups, E.J., Manne, S.L., Heckman, C.J., 2008. Multiple skin cancer risk behaviors in the U.S. population. *Am. J. Prev. Med.* 34, 87–93.
- Dennis, L.K., Vanbeek, M.J., Beane Freeman, L.E., Smith, B.J., Dawson, D.V., Coughlin, J.A., 2008. Sunburns and risk of cutaneous melanoma: does age matter? A comprehensive meta-analysis. *Ann. Epidemiol.* 18, 614–627.
- Diepgen, T., Mahler, V., 2002. The epidemiology of skin cancer. *Br. J. Dermatol.* 146, 1–6.
- Elwood, J.M., Jopson, J., 1997. Melanoma and sun exposure: an overview of published studies. *Int. J. Cancer* 73, 198–203.
- Engholm, G., Ferlay, J., Christensen, N., Kejs, A., Johannesen, T., Khan, S., 2015. NORDCAN: Cancer Incidence, Mortality, Prevalence and Survival in the Nordic Countries, Version 7.1 (09.07.2015). Association of the Nordic Cancer Registries. Danish Cancer Society Available from: <http://www.ncr.nu>, Accessed date: 16 June 2016.
- Ferlay, J., Soerjomataram, I., Ervik, M., Dikshit, R., Eser, S., Mathers, C., Rebelo, M., Parkin, D., Forman, D., et al., 2013. GLOBOCAN 2012 v1.0, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 11 [Internet]. International Agency for Research on Cancer, Lyon, France Available from: <http://globocan.iarc.fr>, Accessed date: 15 February 2018.
- Ghassassi, F.E., Baan, R., Straif, K., Grosse, Y., Secretan, B., Bouvard, V., Benbrahim-Tallaa, L., Guha, N., C., F., et al., 2009. WHO International Agency for Research on Cancer Monograph Working Group. A review of human carcinogens - part D: radiation. *Lancet Oncol.* 10, 751–752.
- Green, A.C., Marquart, L., Clemens, S.L., Harper, C.M., O'Rourke, P.K., 2013. Frequency of sunburn in Queensland adults: still a burning issue. *Med. J. Aust.* 198, 431–434.
- Hall, H.I., Saraiya, M., Thompson, T., Hartman, A., Glanz, K., Rimer, B., 2003. Correlates of sunburn experiences among U.S. adults: results of the 200 National Health Interview Survey. *Public Health Rep.* 118, 540–549.
- Holman, D.M., Berkowitz, Z., Guy Jr., G.P., Hartman, A.M., Perna, F.M., 2014. The association between demographic and behavioral characteristics and sunburn among U.S. adults - National Health Interview Survey, 2010. *Prev. Med.* 63, 6–12.
- Kræftens Bekæmpelse og TrygFondens Solkampagne The Danish Sun Safety Campaigns Webpage (In Danish). Available from: <https://www.cancer.dk/forebyg/skru-ned-for-solen/>, Accessed date: 2 May 2018 (København).
- Pisinger, V., Mikkelsen, S.S., Bendtsen, P., Egan, K.K., Tolstrup, J.S., 2017. The Danish National Youth Study 2014: study design, population characteristics and non-response analysis. *Scand. J. Public Health* 0.
- Statistics Denmark, 2015. Education Level is Rising in All Regions (In Danish). *Nyt fra Danmarks Statistik*:2.
- Veierod, M.B., Weiderpass, E., Thorn, M., Hansson, J., Lund, E., Armstrong, B., Adami, H.O., 2003. A prospective study of pigmentation, sun exposure, and risk of cutaneous malignant melanoma in women. *JNCI J. Natl. Cancer Inst.* 95, 1530–1538.
- WHO, 2017. Skin cancers. Available from: <http://www.who.int/uv/faq/skincancer/en/index1.html>, Accessed date: 2 May 2018.
- Wu, S., Cho, E., Li, W.Q., Weinstock, M.A., Han, J., Qureshi, A.A., 2016. History of severe sunburn and risk of skin cancer among women and men in 2 prospective cohort studies. *Am. J. Epidemiol.* 183 (9), 824–833.