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Factors related to being sunburnt in 7-year-old children in Sweden

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ABSTRACT

Background: Epidemiologic research shows that being sunburnt as a child is an important risk factor for cutaneous malignant melanoma (CMM). The purpose of this study was to investigate sunburn in relation to tanning habits and complexion among 7-year-old children living at different latitudes in Sweden.

Methods: Two municipalities were chosen at latitudes 65°N and 68°N in the north of Sweden and two at latitude 57°N in the south. Children born in 1994 and registered in the municipalities were to be included ($N = 1676$). A questionnaire was sent to their parents asking about their children's tanning habits, and the children were examined. The analysis set comprised 1360 children who participated in the examination and whose parents answered the questionnaire (81.1%).

Results: Twelve percent of all children had been sunburnt during the first 2 years of life compared to 44% between 2 and 4 years and 67% after 4. The children in the south at latitude 57°N compared to Kiruna at latitude 68°N and Piteå at 65°N had a higher risk of ever being sunburnt during the first 2 years of life OR = 1.87 (95% confidence interval (CI) 1.11–3.14) and 1.66 (0.95–2.90), respectively. The differences diminished with age. Sunscreen was an independent risk factor of being sunburnt between 2 and 7 years of age (not or seldom using sun screen was protective). Photosensitive skin type was the main risk factor for sunburns.

Conclusion: Swedish children are frequently sunburnt and children living in the south are more sunburnt than those in the north. Sunscreens that were seldom used or not used at all were found to be protective. These results support previous reports that photosensitive skin type is an important risk factor for suffering sunburn as a child and therefore increases the risk of cutaneous malignant melanoma.

1. Introduction

Skin cancer is emerging as a public health problem in Sweden. Even though the most important risk factor for the development of skin cancer – sun exposure – is known, the incidence of skin cancer is still increasing in Sweden. There is an inverse association between melanoma incidence rates and latitude of residence in Europe with the highest incidence in the north and the lowest in the south,[1] but in Sweden the incidence is doubled in the south compared to the north.[2]

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Sweden has a high incidence: in 2007 2333 people were diagnosed with cutaneous malignant melanoma (CMM), and 3896 with squamous cell carcinoma.[2] Basal cell carcinoma (BCC) is the most common form of skin cancer. BCC was first registered in the Swedish Cancer Registry in 2004 and in 2006, 39,133 cases were reported.[3]

Today it is widely recognised, and there is substantial scientific evidence to support the view, that ultraviolet radiation (UVR) is an important aetiological factor in the induction of all forms of skin cancer.[4,5] Exposure of the skin to excessive UVR causes sunburn and can result in chromosomal damage.[4] In studies of the aetiology, a distinction is often made between intermittent recreational solar exposure and cumulative or total sun exposure. Intermittent solar exposure is hypothesised to be the major cause of CMM.[5] Some studies have showed an increased risk of CMM associated with frequent childhood sunburn.[5,6] There have been many studies of common melanocytic naevi (CMN) in children where exposure to sunlight increased the numbers of CMN.[7–10] Numerous studies have also shown that photosensitive skin type is related to increased numbers of CMN in children.[10–14]

A study of 1–2-year-olds in Sweden found that 35% of all parents spent 2 h or more in the sun during peak hours (11 a.m.–3 p.m.) on a typical work-free day in the summer, and almost 10% of the children were exposed to the sun during that time.[15] A European multicentre study led by the European Organisation for Research Treatment of Cancer (EORTC) Melanoma Cooperative Group examined retrospectively the sun habits of children aged 0–6 years in Belgium, Germany, France and Italy. A steady increase in sun exposure with age was found.[16] Already at a very early age, protection of children from the sun is insufficient.[13] Associations between sunscreen use among children indicated more sun-related skin damage among sunscreen users and more naevi have been reported.[8,10]

The aim of this study was to investigate sunburn in relation to tanning habits and complexion among 7-year-old children residing at different latitudes in Sweden. The prevalence of common melanocytic naevi has been reported earlier.[17]

2. Material and methods

The study comprised two parts, a physical examination including naevi count and a questionnaire about tanning habits. The project was performed in collaboration with the school health services and was approved by the Ethical committee at the Karolinska University Hospital.

Two municipalities were chosen at latitudes 65°N and 68°N in the north of Sweden (Kiruna and Piteå) and two at latitude 57°N in the south (Ljungby and Falkenberg). The Arctic Circle is situated at latitude 66.5°N. Piteå and Falkenberg, both situated on the coast, have on an average more sun hours than inland Kiruna and Ljungby. Factors considered when selecting the municipalities were the number of children of 7 years of age, parents' income level and the rate of unemployment, which need to be as similar as possible.

Information about children born during 1994 and residing in any of the four municipalities in August 2001 was obtained from the national census file. An invitation letter to the parents with information about the study, a written consent form for participation in the physical examination, and the questionnaire, were sent in September 2001. For non-responders, a reminder was sent after 2 weeks.

The questionnaire covered the following topics: – skin reaction to sun in early summer, – whether the child was born with a mole, – number of holidays spent at seaside resorts abroad (before 2 years of age, 2–4 years of age and after 4 years of age), – how often the child sailed and skied during holidays and weekends, – how often the child had been naked in the sun (before 2 years of age, 2–4 years of age and after 4 years of age) – the number of sunburn incidents (before 2 years of age, 2–4 years of age and after 4 years of age), – how often the child was protected with sunscreen, clothes, staying in shadow and staying indoors, – to what degree parents found outdoor tanning attractive, – whether close relatives had been diagnosed with skin cancer, – whether the child had been treated by a doctor for asthma, allergy and eczema, and – highest level of education of each parent.

Details and results from the physical examination were reported in 2007.[17]

2.1. Statistical analysis

The dichotomous variables experience of sunburns once or more before 2 years of age, between 2 and 4 years of age and after 4 years of age, were derived and analysed with logistic regression analysis. In a first step, univariate logistic regression was performed. All covariates with a p-value of 0.10 or less in the univariate analysis were considered for inclusion in a multivariate logistic regression model. The final multivariate model included variables or interactions with p-values of 0.05 or less.

Table 1 – Exposure habits and complexion by skin type and in total.

	Skin type (%)		Total (%)
	I–II	III–IV	
Sunburnt			
0–2 (<) years of age	18	11	12
2–4 (<) years of age	57	42	44
4–7 years of age	84	65	67
Protection			
Often used sunscreen	67	54	56
Often used clothes	65	50	52
Often kept child in the shadow	11	7	8
Often kept the child inside	8	5	6
Never naked in the sun			
0–2 (<) years of age	25	16	17
2–4 (<) years of age	9	3	4
4–7 years of age	10	6	7
Hair colour			
Ash blond or dark	20	33	31
Eye colour			
Brown	15	25	23

Table 2 – Frequency of ever being sunburnt by age for exposure habits and complexion.

			Before 2 years of age (%)	Between 2 and 4 years of age (%)	After 4 years of age (%)
Municipality	Latitude °North	Yearly sum of CIE-UV			
Falkenberg	57.0	65.7	15.4	48.1	70.6
Ljungby	56.9	84.5	13.9	43.0	66.6
Piteå	65.3	104.0	8.7	40.6	62.3
Kiruna	67.8	110.6	8.9	42.5	69.8
Holidays at seaside resorts abroad before 2 years of age					
Ever			19.2	44.8	65.2
Never			10.4	43.2	66.9
Holidays at seaside resorts abroad between 2 and 4 years of age					
Ever			–	50.4	66.6
Never			–	41.6	63.9
Holidays at seaside resorts abroad after 4 years of age					
Ever			–	–	69.6
Never			–	–	65.2
Parents's attitude to outdoor tanning					
Very much			14.0	45.3	67.6
Fairly much			12.0	45.7	71.4
Neither like or dislike outdoor tanning			8.9	38.8	58.7
Rather not or not at all			12.1	41.5	68.6
Sun screen use					
Never or seldom			8.8	29.8	46.3
Sometimes			12.7	46.0	66.8
Often			12.0	45.8	72.3
Clothes					
Never or seldom			7.9	36.3	50.0
Sometimes			13.6	46.1	68.4
Often			10.5	42.7	68.4
Keep in shade					
Never or seldom			12.8	46.3	66.8
Sometimes			9.3	40.9	68.4
Often			12.2	41.9	63.9
Keep inside					
Never			12.1	46.0	65.9
Seldom			11.9	43.8	69.6
Sometimes or often			10.6	40.5	66.1
Naked in the sun before 2 years of age					
Sometimes or often			17.7	47.8	66.4
Seldom or never			7.0	40.3	67.0
Naked in the sun between 2 and 4 years of age					
Sometimes or often			–	46.4	66.8
Seldom or never			–	36.6	66.3
Naked in the sun after 4 years of age					
Sometimes or often			–	46.4	68.0
Seldom or never			–	36.6	62.9
Education mother					
Compulsory + vocational training school			12.3	41.8	72.3
Upper secondary school			11.1	43.4	65.5
University (exam + no exam)			12.9	43.7	66.8
Education father					
Compulsory + vocational training school			14.0	41.9	68.0
Upper secondary school			10.5	44.1	67.7
University (exam + no exam)			14.0	43.6	62.6
Skin type					
I or II			18.1	57.1	84.4
III or IV			10.9	41.9	64.7
Hair colour					
Red or blond			12.2	44.9	69.9
Ashblond or dark			10.8	40.7	60.5
Eye colour					
Blue, grey or green			12.2	46.0	70.2
Brown			10.2	35.9	56.8
Gender					
Girls			11.4	42.5	67.6
Boys			12.1	44.8	66.4

3. Results

In total 1676 children of the relevant ages resided in the municipalities in 2001. For 1469 (87.5%) the questionnaire was filled out. Children with brown or black skin were excluded from the analyses. The analyses included only children who had been physically examined and whose parents answered the questionnaire (N = 1360) (81.1%).

Twelve percent of all the children had been sunburnt during the first 2 years of life compared to 44% between 2 and 4 years and 67% after 4 years (Table 1). Children with skin type I or II had a higher frequency of ever being sunburnt at all ages compared to those with skin type III or IV. It was more common to protect children with skin type I or II. A correlation between skin types III and IV with dark hair and brown eyes was observed. Fifty-six percent of the parents often applied sunscreens on the children, 39% sometimes and only 4% not at all. Fifty-two percent of the children were often and 2% were never protected with clothes. Eight percent of the children were often kept in the shadow and 24% never were.

Descriptive statistics of ever being sunburnt in different ages and for exposure habits and complexion are presented in Table 2. Results of univariate and multivariate analyses are presented in Tables 3 and 4, respectively.

Sunburns increased with age in all communities (Table 2). No differences were seen between the municipalities at the same latitude. There was a difference between the south and the north of Sweden before 2 years of age but the difference disappeared in older age groups. Holidays at seaside resorts abroad after 2 years of age, parent's attitude to outdoor tanning, parent's education and gender did not have any important influence on children being sunburnt. The complexion parameters, however, did show differences with more sunburns among those who of skin type I or II, with non-brown eyes and lighter hair. Among those who never or seldom were protected by sunscreens the frequency of sunburns was lower.

The children residing in Falkenberg and Ljungby at latitude 57°N had a higher risk of ever being sunburnt during the first 2 years of life compared to Kiruna at latitude 68°N, OR = 1.87 and 1.66, respectively (Table 3). The differences diminished with age.

For those children with red hair there was a higher risk of being sunburnt and for those with blond hair there was a tendency to be more sunburnt compared to those with dark hair (Table 3). Green, blue or grey eyes implied a higher risk than brown eyes (Tables 3 and 4). There was no difference between municipality and latitudes regarding skin type or hair colour (not shown in table). There was no significant gender difference. After 4 years of age the risk of being sunburnt was almost three times higher among those with skin types I and II. Before 4 years of age the risk almost doubled (Table 3).

Parents in the south protected their children more often with sunscreens than those in the north did (Table 3). Regarding clothes, the situation was the opposite, the children in the north being more protected. Eighty-three percent of the children had been naked in the sun before 2 years of age and the OR for sunburn was 2.85. In the north it was less common to let the child be naked in the sun and more common to use protective clothing (not shown in table).

There was a doubled risk of sunburn if the child had been at a seaside resort abroad before 2 years of age (Table 3). However, we lack information as to whether they had been sunburnt abroad or in Sweden. Sixteen percent of the children had been on a holiday at seaside resorts abroad before 2 years of age, 25% between 2 and 4 years of age and 40% after four years of age (not shown in the table). There were no significant differences before 4 years of age between those living in the north and in the south of Sweden. After 4 years of age, 46% of the 'southerners' had been abroad compared to 34% among those living in the north.

Independent risk factors found in the multivariate analysis of being sunburnt before 2 years of age were being naked in the sun, skin photo type I or II or vacation abroad (Table 4). Between 2 and 4 years of age the most important risk factor was sunscreen use (not using sun screen was protective) followed by skin type I or II, being naked in the sun and vacation abroad. After 4 years of age sunscreen use, skin type I or II, red or blond hair colour and parent's positive attitude to sunbathing were independent risk factors for ever being sunburnt.

Neither the mother's nor the father's educational level had any influence on sunburn among the children.

4. Discussion

This is the first Swedish study to compare sunbathing habits at different latitudes among children. The incidence of CMM is doubled in the south compared to that in the north of Sweden,[2] and to have been sunburnt as a child is considered one of the most important risk factors for CMM. Our study demonstrates that Swedish children are sunburnt to a larger extent and this is associated with lower latitude and photosensitive skin types. Before 2 years of age, a higher proportion of children in the south are sunburnt than in the north, and this cannot be explained by skin type. None or seldom use of sunscreen was protective for sunburns.

The UV dose is higher in the south of Sweden than in the north and the yearly sum of CIE-UV (Whm-2), weighted according to International Commission on Illuminations, has a range from 65.7 in the north to 110.6 in the south (Table 2). It thus seems reasonable with more sunburns in the south. An increased risk was observed for ages 0–2 years, (Table 3) but not in older ages. The reason for this is unclear. It may be that with increasing age the parents recognise the skin type of their children, leading to a better sun protection for sun-sensitive children or that protection overall decreases by age. The parents in the north of Sweden reported that they protected their children against sun more than those in the south. However, it is as likely that they protect their children against colder climate throughout the year and possible mosquitoes during the summer.

It is alarming that children often protected with sunscreens suffered more sunburn than those who never were or seldom were protected. A review by Autier and colleagues[18] showed that sunburns tended to be more frequent among sunscreen users. The conclusion was that sunscreen use leads to longer duration of sun exposure when sun exposure is intentional, but not when sun exposure is non-intentional.

Table 3 – Odds ratios (OR) and 95% confidence limits (CI) for ever being sunburnt, univariate analyses of exposure and complexion.

	Before 2 years of age		Between 2 and 4 years of age		After 4 years of age	
	OR	CI	OR	CI	OR	CI
Municipality						
Falkenberg (57.0°N) versus Kiruna (67.8°N)	1.87	1.11–3.14	1.26	0.91–1.73	1.04	0.73–1.47
Ljungby (56.9°N) versus Kiruna (67.8°N)	1.66	0.95–2.90	1.02	0.72–1.44	0.86	0.60–1.24
Piteå (65.3°N) versus Kiruna (67.8°N)	0.98	0.56–1.71	0.92	0.67–1.27	0.71	0.51–1.00
Holidays at seaside resorts abroad						
Ever versus never	2.04	1.33–3.14	1.44	1.09–1.88	1.22	0.96–1.56
Parents's attitude to outdoor tanning						
Very much versus rather not or not at all	1.18	0.62–2.25	1.17	0.76–1.79	0.95	0.61–1.50
Fairly much versus rather not or not at all	0.99	0.54–1.83	1.19	0.79–1.77	1.14	0.74–1.76
Neither like or dislike it versus rather not or not at all	0.72	0.36–1.42	0.89	0.58–1.38	0.65	0.41–1.02
Sun screen use						
Never or seldom versus often	0.71	0.40–1.26	0.50	0.35–0.72	0.33	0.23–0.46
Sometimes versus often	1.07	0.74–1.55	1.01	0.79–1.28	0.77	0.59–1.00
Clothes						
Never or seldom versus often	0.73	0.32–1.64	0.76	0.48–1.20	0.46	0.30–0.72
Sometimes versus often	1.35	0.95–1.91	1.15	0.91–1.44	1.00	0.79–1.28
Keep in shade						
Never versus often	1.09	0.53–2.22	0.93	0.58–1.49	0.88	0.55–1.42
Seldom versus often	1.03	0.51–2.05	1.42	0.90–2.23	1.37	0.86–2.18
Sometimes versus often	0.73	0.36–1.49	0.96	0.61–1.51	1.22	0.77–1.94
Keep inside						
Never versus sometimes or often	1.15	0.75–1.77	1.25	0.95–1.64	0.99	0.75–1.31
Seldom versus sometimes or often	1.14	0.71–1.81	1.15	0.85–1.54	1.17	0.86–1.60
Naked in the sun						
Sometimes or often versus seldom or never	2.85	1.99–4.08	1.49	1.17–1.91	1.26	0.97–1.63
Education mother						
Compulsory + vocational training school versus University (exam + no exam)	0.94	0.54–1.65	0.93	0.64–1.35	1.30	0.87–1.95
Upper secondary school versus University (exam + no exam)	0.84	0.58–1.22	0.99	0.77–1.26	0.95	0.73–1.22
Education father						
Compulsory + vocational training school versus University (exam + no exam)	1.01	0.62–1.63	0.94	0.67–1.32	1.26	0.89–1.80
Upper secondary school versus University (exam + no exam)	0.73	0.48–1.10	1.02	0.77–1.36	1.25	0.93–1.68
Skin type						
I or II versus III or IV	1.80	1.18–2.76	1.84	1.34–2.54	2.95	1.93–4.49
Hair colour						
Red hair versus ash blond or dark	2.51	1.02–6.20	2.38	1.10–5.17	2.61	1.04–6.52
Blond versus ash blond or dark	1.10	0.76–1.61	1.16	0.91–1.47	1.49	1.17–1.90
Eye colour						
Blue, grey, or green versus brown	1.23	0.81–1.87	1.52	1.17–1.98	1.79	1.38–2.32
Gender						
Girls versus boys	0.94	0.67–1.31	0.91	0.73–1.13	1.05	0.84–1.32

Results of European randomised trials suggest that sunscreen users are unaware of the impact sunscreen use has on their sun exposure behaviours. Our questionnaire did not ask for use of sunscreens at different ages or whether the same pattern of use was followed abroad as at home. One problem with sunscreens is that they are not always used as intended. In a Swedish study most of the parents to 4-year-old children reported that it was difficult to apply sunscreens and to know if these were correct.[19]

The Swedish Environmental Health Report of 2005 stated that all kinds of sun protection decreased with age,[20] from 84% at the age of 4 years to 57% at the age of 12, for any pro-

Table 4 – Odds ratios (OR) with 95% confidence interval (CI) for being sunburnt based on multivariate logistic regression.

	OR	CI
Before 2 years of age		
Naked in the sun before 2 years of age		
Sometimes or often versus seldom or never	2.71	1.88–4.02
Skin type		
I or II versus III or IV	2.34	1.44–3.80
Holidays at seaside resorts abroad before 2 years of age		
Ever versus never	2.12	1.36–3.30
Between 2 and 4 years of age		
Sun screen use		
Never or seldom versus often	0.49	0.33–0.73
Sometimes versus often	1.13	0.86–1.49
Skin type		
I or II versus III or IV	1.97	1.37–2.82
Naked in the sun between 2 and 4 years of age		
Sometimes or often versus seldom or never	1.49	1.13–1.95
Holidays at seaside resorts abroad between 2 and 4 years of age		
Ever versus never	1.50	1.13–2.00
After 4 years of age		
Sun screen use		
Never or seldom versus often	0.38	0.26–0.54
Sometimes versus often	0.79	0.60–1.04
Skin type		
I or II versus III or IV	2.69	1.75–4.16
Hair colour		
Red/blond versus Ashblond/dark	1.62	0.62–4.25
Blond versus Ashblond/dark	1.42	1.10–1.84
Parents's attitude to sun bathing		
Very much versus rather not or not at all	0.94	0.58–1.54
Fairly much versus rather not or not at all	1.02	0.64–1.62
Neither like or dislike it versus rather not or not at all	0.60	0.37–0.98

tection in Sweden or in northern Europe. It was also more common to protect children when on a seaside vacation abroad than to do so in Sweden. The corresponding numbers were 92% at the age of 4 and 84% at the age of 12. This could explain the increase in sunburn with age, as also reported by Hall and colleagues.[21]

A self-administrated questionnaire may admit both over- and underreporting, but there is no reason to believe that in general there should be any differences between the municipalities even if the questions about protection could influence the answers. The fact that this is a population-based study implies that all individuals were identified and offered to participate. The non-participation rate was the same in all four municipalities.

The results support findings in previous studies that it is common that children get sunburnt. In a study of children in the same age groups in Colorado,[22] 68% had been sunburnt anywhere on the body, the same proportion as in our study. In southern Italy 40% of children with a median age of 8 had been sunburnt, while Autier and colleagues[23] reported that 54% of children aged 6–7 in southern Europe had been sunburnt. In the Swedish study by Bränström and colleagues from Stockholm, (the capital), about 20% of children had been sunburnt between 1 and 2 years of age.[15]

Fair-skinned persons get sunburnt more easily than dark-skinned persons. Our results are in line with this, and the fact that 'our' children with blond hair and green, blue or grey eyes became more sunburnt more easily than other types indicate good validity in our questionnaire. The hair and eye colours were classified by our study nurse.

Swedish families travel a lot even with very young children. Forty percent of children between 4 and 7 years of age have been to a sunny resort abroad compared to 16% before 2 years of age. In the previously mentioned study from Stockholm,[15] 35% had been abroad between 1 and 2 years of age. In the south of Europe, 12% of children studied had spent their first year of age in places more than 8° south of their latitude of residence, compared with 23% by the age of 6 years.[16]

We found no increased risk of sunburn among the children whose parents liked tanning. Another study from Sweden showed that parents' own time in the sun was positively related to their children's.[15] Being of the opinion that children look healthier when tanned was also positively associated with childhood sunburn. However, such questions were not included in our questionnaire.

It seems that knowledge, information and attitudes have a stronger influence on sun-related behaviour than level of education.[15] The lack of association between knowledge and

actual behaviour has been documented.[24] Bränström and colleagues also found that many parents consider a tanned complexion to be a sign of health in their child.[15]

Parent's education level did not influence the risk of sunburn, maybe because 99% of the adult population in Sweden is aware of the correlation between high ultraviolet radiation and skin cancer.[25] In the study among little children in Sweden,[15] it was shown that the more the parents knew about the risks of skin cancer the greater was the likelihood that the child was properly protected when in sun.

As children in the south of Sweden got more sunburnt, especially at a younger age, than children in the north, more prevention must be implemented in the south. Even if the parents have a high awareness of the importance of protecting their children, the use of sunscreen is maybe not the best method. Not using sunscreen is protective for sunburns and therefore more use of clothes is desirable. However, there is a long tradition of recommending sunscreens, both from the medical profession, media and from commercial advertising. Sunscreens may convey false security which can lead to that the young users get more burnt and thereby have a future risk of skin cancer. Advice to parents and to teachers at primary schools is to protect children of all ages, especially those with skin types I and II. Randomised controlled sun-protection intervention trials to evaluate the effectiveness of sun-protective programs are desirable in Sweden.

Conflict of interest statement

None declared.

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