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A comparison of patterns of sun protection during beach holidays and everyday outdoor activities in a population sample of young German children

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Summary

Background Reducing exposure to ultraviolet (UV) radiation is the main effective measure for preventing skin cancer. Educational campaigns targeting sun protection have been focused either on behaviour on the beach during the summer holiday alone, or during everyday outdoor activities of the children. Little is known about the comparison between these different settings.

Objectives To analyse whether parents apply similar protective measures to reduce UV exposure for their young children in different outdoor environments.

Methods Families (n = 2619) with children aged 3–6 years (response: 64·7%) were enrolled in a population-based survey in the German city of Erlangen and its surrounding rural county. Using a self-administered standardized questionnaire parents gave information about demographic and photosensitivity data of their children, their knowledge about risk factors for skin cancer and their typical instructions given to their children when these played outside on a summer day in different outdoor environments.

Results Significant discrepancies regarding the four UV protective measures (clothes, shade, sunhat, sunscreen) for children between an everyday outdoor setting and a holiday setting on the beach were observed. A high level of parental risk factor knowledge was significantly associated with a better protection for children in all four measures only on the beach. Photosensitivity and demographic characteristics had some impact on protective behaviour, too. Measures of sun protection were reduced with children's increasing age.

Conclusions Skin cancer prevention campaigns should target the encouragement of sun protection for children also in outdoor activities of daily living, not only during a summer holiday on the beach.

The incidence of melanoma and nonmelanoma skin cancer has been increasing worldwide in fair-skinned populations during the last decades.[1] It has been recognized that exposure to ultraviolet (UV) radiation, which will even gain in importance due to thinning and dwindling of the ozone layer, is the main modifiable risk factor for skin cancer.[2,3] Irrespective of an even deeper understanding of the mechanisms regarding how UV radiation causes skin cancer on the individual level,[4] reduction of sun exposure and protection of the skin against harmful effects of UV radiation have become established cornerstones of prevention campaigns to prevent a further, rapid increase of skin cancer incidence on the population level.[5]

Children should be addressed as a special subgroup in prevention programmes.[6,7] About 25–50% of the lifetime UV exposure apparently occurs before 18–21 years of age.[8–10] Moreover, the average yearly dose of UV exposure a child receives is three times higher than the dose adults receive annually and a significant portion of this exposure occurs during summer midday hours.[11,12] As frequent sunburns as well as elevated levels of cumulative UV radiation are established risk factors for skin cancer,[13,14] sun protection particularly for children is an important public health topic. In most instances, parents are responsible for the extent of sun exposure of their young children and they act as a role model for their children. Hence, their knowledge and awareness of the problem are critical for the protection of their children against excessive UV exposure.[15]

Several educational public health campaigns targeting sun-protective behaviour have been performed in Australia, the U.S.A. and Europe during the last decades.[16–20] Studies

assessing actual behaviour were, however, focused on behaviour either on the beach during the summer holiday alone,[21–23] or during usual daily outdoor activities of the children.[24] It has not yet been analysed whether parents apply similar protective measures to reduce UV exposure for their children in different settings, e.g. when playing on the beach during holidays as compared with the situation when playing in the garden. Such a 'garden' setting also represents the everyday outdoor use of playgrounds, public parks etc. at a central European latitude of 49°35′N in this context, whereas the 'beach' setting should be understood as a typical holiday situation at the seaside in sunny regions. In the current questionnaire-based study we investigated these issues as well as factors associated with sun-protective behaviour, namely, parents' knowledge and their children's demographic and photosensitivity characteristics.

Materials and methods

Participants

The sample of the ErlKing (ERlangen KINderGarden) study, which was performed during the winter 2001/2002, has been drawn from the population in the Northern Bavarian district of Erlangen comprising the city of Erlangen and its surrounding rural county. Using official administrative information we selected 59 of the 118 nursery schools in the study region, 30 from the city and 29 from the county. This selection was, however, not the result of a simple random sampling as we excluded those with a low number of children for logistical reasons. Altogether 4146 questionnaires were distributed to the parents with logistic support by the pre-primary education teaching professionals. If a family had two or more children attending the nursery school, only the data of an index child, defined as the oldest child in this household attending the nursery school, were included in the analysis, which means that the sampling unit of the study was the household and all information referred to children from different families. Finally, 2682 anonymous questionnaires were returned (64·7% response). Of these, 63 had to be excluded as the children's age was out of the range of 3–6 years, yielding a sample size of $n = 2619$. Of the questionnaires included in our analysis, 87·7% were completed by the mother alone, 5·4% by the father alone, 6·2% by both parents, and the small remainder by other family members. The study was approved by the local ethics committee at the University of Erlangen-Nuremberg.

Questionnaire

The self-administered standardized questionnaire addressed demographic characteristics, i.e. age and gender of the child, age of mother and father, and photosensitivity data, such as freckling, hair colour and iris colour of the child. For the analysis, information on the hair colour was classified into two categories: fair hair (red or blonde) and dark hair (brown or black), and iris colour into fair iris (blue or green) and dark iris (brown). Next, knowledge about risk factors of skin cancer was assessed in the questionnaire using the same approach as already employed in earlier studies.[25] To this end, the responders were asked to judge nine exposures with regard to skin cancer risk, which included a mix of true risk factors and exposures attracting public awareness, but not having been identified as factors increasing skin cancer risk. The pattern of answers was summarized by a score that was further classified for the analysis into three categories: low, medium and high knowledge. Finally, parents were questioned regarding typical instructions given to their children when they played outside on a summer day in two different settings, the 'garden' and the 'beach' situation. Four aspects relevant for UV protection were assessed: (i) type of clothing, (ii) frequency of staying in the shade, (iii) wearing a sunhat, and (iv) use of sunscreens. Questionnaires with identical items have been used in earlier surveys and have been described in detail elsewhere.[25,26]

Statistical analysis

Analytical procedures were performed using SAS 9.2 (SAS Institute Inc., Cary, NC, U.S.A.). Discrepancies in the four measures of sun protection between the two settings were tested using McNemar's test for dichotomous variables and Bowker's test for polytomous variables. The crude (bivariate) associations between measures of sun protection and parental risk factor knowledge as well as children's age were assessed using the Cochran–Mantel–Haenszel test. In order to control for confounding, adjusted odds ratios (ORs) and their 95% confidence intervals (CIs) based on logistic regression analysis were used to evaluate further the impact of parental risk factor knowledge as well as children's age on measures of sun protection in separate models for each measure. To this end, the three measures of sun protection originally assessed with several categories were reclassified into dichotomous outcomes as follows: clothing into 'unprotected' (naked or swimsuit) vs. 'protected' (T-shirt or long-sleeved clothes); shade into 'unprotected' (rarely or occasionally) vs. 'protected' (mostly or always); sunscreen into 'unprotected' (rarely or once a day) vs. 'protected' (every 2–3 h). Covariates included in these analyses as potential confounders were demographic and photosensitive variables as mentioned above. $P < 0·05$ from two-sided statistical tests was considered statistically significant.

Results

Among the index children, 49·5% were girls. The mean ± SD age of girls and boys was 4·5 ± 1·0 and 4·6 ± 1·0 years, respectively. The age of mothers ranged from 18 to 51 years, the age of fathers ranged from 21 to 69 years, the mean ± SD being 34·3 ± 4·6 and 36·9 ± 5·3 years, respectively. Hair colour of the children was fair in 65%, irises dark in 32%. There were virtually no differences between genders regarding the

distributions of photosensitivity attributes. Concerning parental knowledge about skin cancer risk factors, 1068 responders (41%) had a high level, 967 (37%) a medium level and 584 (22%) a low level of knowledge.

The distribution of the UV-protective measures for children is listed in Table 1; significant differences between the two settings were found for all four. In the bivariate analyses, parental risk factor knowledge was significantly associated with all four measures of UV protection only in the 'beach' setting; no such relationship was observed in the 'garden' setting (Table 2). Logistic regression analysis addressing potential confounding confirmed this finding. As shown in Table 3, the odds of unprotected clothing (naked or swimsuit) for children in the 'beach' environment were increased by 49% (OR 1·49, 95% CI 1·17–1·90) if parents had a low level of risk factor knowledge compared with parents with a high level of knowledge, controlling for other covariates. The other three protective measures presented the same trend and magnitude of effect in this setting. In contrast, no associations between parental risk factor knowledge and application of sun-protective measures were apparent in the 'garden' setting.

The distribution of the four protective measures across age groups of the children is shown in Table 4. In these bivariate analyses, we observed a significant association between children's age and the items shade, sunhat and sunscreen in the 'garden' setting, as well the items shade and sunhat in the 'beach' setting, respectively. In accordance with these observations, a significant effect of age on protective behaviour was confirmed in logistic regression analyses (Fig. 1), with a general trend for less intense protection in older children. For example, the adjusted OR of 1·89 (95% CI 1·41–2·54) for the comparison of children aged 6 years vs. those aged 3 years in the model for clothing in the beach setting (upper left part of Fig. 1) means that the older children show a significantly elevated, nearly doubled odds of being unprotected with respect to clothing in the beach environment than the younger children.

Parents also reported a different protective behaviour depending on their children's photosensitivity as represented by a number of constitutional factors (hair colour, iris colour, freckling). In particular, they used sunscreens for fair-haired children more frequently than for dark-haired children in the 'garden' setting ($P = 0{\cdot}01$ in the adjusted analysis). Moreover, boys and children with a fair iris colour wore sunhats more often than girls ($P < 0{\cdot}01$ in the adjusted analyses in both settings) and children with a darker iris colour ($P < 0{\cdot}02$ in the adjusted analyses in both settings), respectively. Parents' age had some impact on their protection behaviour, too. Younger mothers had their children wear a sunhat more frequently than older mothers in the 'garden' setting ($P < 0{\cdot}01$ in the adjusted analysis). Regarding fathers, a younger age was associated with a more frequent use of sunscreens, both in the 'garden' and the 'beach' setting ($P = 0{\cdot}04$ in both adjusted analyses).

Table 1 Measures of sun protection for young children in two outdoor environments based on parents' answers in the ErlKing study

	Garden setting, n (%)	Beach setting, n (%)	P-value[a]
How do you usually dress your child?			
Naked	97 (3·8)	190 (7·9)	< 0·01
Swimsuit	274 (10·5)	1442 (59·9)	
T-shirt/shorts	2209 (84·6)	714 (29·7)	
Long sleeves	30 (1·1)	60 (2·5)	
Do you try to keep your child playing in shade?			
Rarely/never	217 (8·3)	106 (4·4)	< 0·01
Occasionally	937 (36·0)	646 (27·0)	
Mostly	1268 (48·7)	1263 (52·7)	
Always	183 (7·0)	381 (15·9)	
Does your child usually wear a sunhat?			
No	664 (25·7)	217 (9·1)	< 0·01
Yes	1916 (74·3)	2164 (90·9)	
Do you use sunscreen for your child?			
Never or rarely	295 (11·4)	34 (1·4)	< 0·01
Once a day	1539 (59·3)	468 (19·4)	
Every 2–3 h	762 (29·3)	1905 (79·2)	

All data are shown as absolute frequencies and proportions (%, in brackets). Due to missing data the sum of subgroups does not equal the total sample size of 2619 for all items. [a]McNemar's test is used for the dichotomous variable ('wearing a sunhat'), and Bowker's test for the other variables.

Discussion

Current messages from skin cancer prevention in the U.S.A., Australia and several European countries address avoiding sun exposure during peak UV times around noon, seeking shade, using appropriate clothing and applying sunscreens with a high sun-protection factor. In our population-based survey we assessed to what extent parents with children aged 3–6 years follow this advice in practice, thereby presenting empirical data on what has been achieved by educational campaigns so far. One element of this repertoire of protective measures, the use of sunscreens, has been the subject of much controversial scientific discussion during recent years.[27,28] It is not the focus of our paper to take up this discussion. Nevertheless, our data show that sunscreen use is frequently adopted by parents as a presumably protective measure for their young children and thus emphasize that recommendations based on conclusive evidence are very much needed.

To the best of our knowledge, previous studies investigated sun-protection behaviour of children during beach holidays[21–23] or in everyday circumstances;[24] however, no study has yet compared sun-protection activities between these settings. The present study based on a quite large sample of households is the first of its kind comparing sun-protection measures adopted by parents of young children in a holiday ('beach') setting vs. an everyday ('garden') setting. Our comparison identified several marked differences between these two environments. For instance, wearing a T-shirt on the beach, where swimwear prevails, is much less common than wearing a T-shirt during everyday outdoor activities. While this differ-

Table 2 The relationship between risk factor knowledge and the four types of protective measures in two outdoor settings based on parents' answers in the ErlKing study

	Risk factor knowledge			
	High, n (%)	Medium, n (%)	Low, n (%)	P-value[a]
Garden setting				
Clothing				
'Unprotected'	141 (13·2)	154 (16·0)	76 (13·1)	0·74
'Protected'	927 (86·8)	809 (84·0)	503 (86·9)	
Shade				
'Unprotected'	470 (44·2)	427 (44·4)	257 (44·3)	0·94
'Protected'	594 (55·8)	534 (55·6)	323 (55·7)	
Sunhat				
No	262 (24·8)	242 (25·3)	160 (28·2)	0·16
Yes	795 (75·2)	713 (74·7)	408 (71·8)	
Sunscreen				
'Unprotected'	753 (71·0)	672 (69·8)	409 (71·5)	0·93
'Protected'	308 (29·0)	291 (30·2)	163 (28·5)	
Beach setting				
Clothing				
'Unprotected'	631 (62·3)	637 (71·9)	364 (71·8)	< 0·01
'Protected'	382 (37·7)	249 (28·1)	143 (28·2)	
Shade				
'Unprotected'	286 (28·3)	292 (33·0)	174 (34·7)	< 0·01
'Protected'	723 (71·7)	594 (67·0)	327 (65·3)	
Sunhat				
No	79 (7·9)	79 (9·0)	59 (11·8)	0·02
Yes	925 (92·1)	796 (91·0)	443 (88·2)	
Sunscreen				
'Unprotected'	188 (18·6)	180 (20·3)	129 (25·7)	< 0·01
'Protected'	824 (81·4)	707 (79·7)	374 (74·4)	

All data are shown as absolute frequencies and proportions (%, in brackets). Due to missing data for some items the sum does not equal the total sample size of 2619 for all items. [a]Cochran–Mantel–Haenszel χ^2 test for trend.

Table 3 The impact of parental risk factor knowledge on protective behaviour in the two outdoor settings

	Garden setting		Beach setting	
	Low vs. high, OR (95% CI)	Low vs. medium, OR (95% CI)	Low vs. high, OR (95% CI)	Low vs. medium, OR (95% CI)
Clothing: 'unprotected' vs. 'protected'	1·04 (0·76–1·42)	0·82 (0·60–1·11)	1·49 (1·17–1·90)	1·00 (0·78–1·29)
Shade: 'unprotected' vs. 'protected'	1·00 (0·80–1·23)	0·98 (0·79–1·22)	1·34 (1·06–1·70)	1·08 (0·85–1·37)
Sunhat: no vs. yes	1·15 (0·90–1·47)	1·15 (0·90–1·48)	1·50 (1·02–2·18)	1·28 (0·87–1·87)
Sunscreen: 'unprotected' vs. 'protected'	1·03 (0·82–1·31)	1·09 (0·86–1·39)	1·42 (1·09–1·85)	1·31 (0·99–1·71)

Odds ratio (OR) estimates with accompanying 95% confidence intervals (CIs) are derived from separate logistic regression models incorporating gender and age of child, age of mother and father, hair and iris colour as potential confounders (first-order interaction terms were examined but not included in the final model due to irrelevance).

ence can easily just be attributed to common clothing habits, and the fact that children will not only stay on the beach, but also go in the water from time to time, it also reflects a lack of awareness regarding sun protection on the beach, where children could, and should, wear more protective garments. For example, in an Australia cohort study the young children in the intervention group were dressed in swimwear suits (UV protection factor ≥ 40) with long sleeves with either full or knee-length legs and wore legionnaire hats.[29] The outcome of this cohort study is not yet published, so we do not know the effect of such protective garments, but this pattern of dressing could be desirable.

With the exception of clothing, as discussed above, parents more frequently chose a higher level of protection for their children on the beach compared with outdoor everyday activities. Thus, children were protected more carefully in the

Table 4 Measures of sun protection stratified for children's age in two outdoor settings based on parents' answers in the ErlKing study

	Age of 3 years, n (%)	Age of 4 years, n (%)	Age of 5 years, n (%)	Age of 6 years, n (%)	P-value[a]
Garden setting					
Clothing					
Naked	28 (6·5)	29 (3·7)	32 (3·7)	8 (1·5)	0·14
Swimsuit	35 (8·2)	89 (11·2)	84 (9·7)	66 (12·6)	
T-shirt/shorts	360 (83·9)	658 (83·3)	746 (85·9)	445 (85·1)	
Long sleeves	6 (1·4)	14 (1·8)	6 (0·7)	4 (0·8)	
Shade					
Rarely/never	22 (5·1)	73 (9·2)	82 (9·4)	40 (7·7)	< 0·01
Occasionally	148 (34·6)	250 (31·7)	321 (37·0)	218 (41·9)	
Mostly	228 (53·3)	400 (50·7)	414 (47·7)	226 (43·5)	
Always	30 (7·0)	66 (8·4)	51 (5·9)	36 (6·9)	
Sunhat					
No	80 (18·7)	175 (22·4)	241 (28·23)	168 (32·4)	< 0·01
Yes	348 (81·3)	606 (77·6)	612 (71·7)	350 (67·6)	
Sunscreen					
Never/rarely	40 (9·4)	91 (11·6)	104 (12·0)	60 (11·6)	0·03
Once a day	247 (58·0)	451 (57·4)	524 (60·5)	317 (61·2)	
Every 2–3 h	139 (32·6)	244 (31·0)	238 (27·5)	141 (27·2)	
Beach setting					
Clothing					
Naked	50 (12·5)	65 (9·1)	66 (8·1)	9 (1·9)	0·07
Swimsuit	190 (47·5)	400 (55·8)	515 (63·1)	337 (71·2)	
T-shirt/shorts	146 (36·5)	227 (31·6)	221 (27·1)	120 (25·4)	
Long sleeves	14 (3·5)	25 (3·5)	14 (1·7)	7 (1·5)	
Shade					
Rarely/never	15 (3·8)	31 (4·3)	35 (4·3)	25 (5·3)	0·02
Occasionally	97 (24·5)	182 (25·4)	236 (29·0)	131 (27·9)	
Mostly	216 (54·5)	388 (54·1)	404 (49·6)	255 (54·4)	
Always	68 (17·2)	116 (16·2)	139 (17·1)	58 (12·4)	
Sunhat					
No	22 (5·5)	65 (9·2)	83 (10·3)	47 (10·0)	0·02
Yes	376 (94·5)	641 (90·8)	723 (89·7)	424 (90·0)	
Sunscreen					
Never/rarely	4 (1·0)	16 (2·2)	11 (1·3)	3 (0·6)	0·40
Once a day	74 (18·5)	116 (16·2)	180 (22·1)	93 (19·8)	
Every 2–3 h	321 (80·5)	585 (81·6)	625 (76·6)	374 (79·6)	

All data are shown as absolute frequencies and proportions (%, in brackets). Due to missing data for some items the sum does not equal the total sample size of 2619 for all items. [a]Cochran–Mantel–Haenszel χ^2 test is used to assess a trend over age groups.

'beach' setting than in everyday routine, probably because the 'beach' setting is regarded as a high-risk environment as the mean daily time of outdoor exposure during holidays is usually longer than during daily life[30] and the intensity of UV radiation is mostly higher on the beach in (southern) holiday regions than at home. Sun protection in everyday situations was thus apparently not considered as pressing a necessity as during the exceptional situation of a sunny holiday. However, a potential hazard lies in the fact that in cumulative terms children spend more time in everyday situations as captured by the 'garden' setting than on holidays in the 'beach' setting. Cumulative UV exposure, in turn, is known to be strongly linked to the development of melanoma and nonmelanoma skin cancers.[13,31,32] Furthermore, even moderate sun exposure during everyday outdoor activities has been shown to be sufficient to induce melanocytic naevi in children,[33] thereby increasing skin cancer risk in the future.[34–36]

The apparent difference in protective behaviour between the two environments may reveal a misunderstanding about sun exposure. Parents might think that the solar radiation on the beach is intensive and harmful, while it is mild and harmless in the garden and similar everyday outdoor settings. A substantial proportion of parents seems to be unaware of the necessity to adopt protective measures for their children also in everyday situations during summertime. The relationship between risk factor knowledge and protective measures taken in the two settings provides some evidence to support this notion. We found a significant association between a higher parental level of knowledge and a better level of protection implemented for the children only for the 'beach' setting.

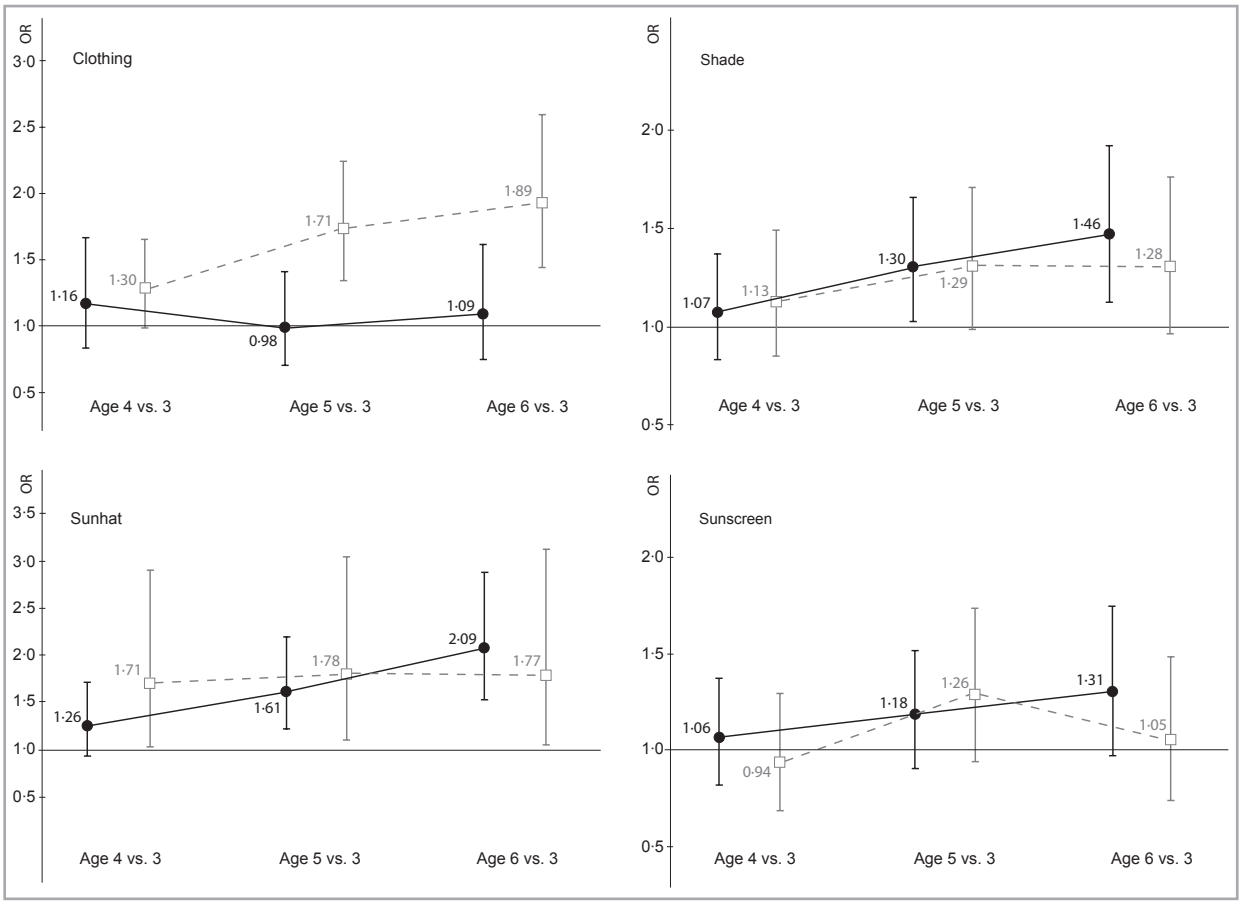

Fig 1. The impact of children's age on sun-protective behaviour in two outdoor settings. The association between the children's age and the four measures of the sun protection (clothing, shade, sunhat, sunscreen) were evaluated separately in logistic regression models incorporating parental risk factor knowledge, age of mother and father, gender, children's hair and iris colour as confounders (first-order interaction terms were examined but not included in the final model due to irrelevance). Adjusted odds ratios (ORs) with accompanying 95% confidence intervals (CIs) are presented to describe the effect of children's age relative to the youngest group on the odds of revealing an 'unprotected' behaviour in the corresponding outdoor environment. CIs are shown in solid vertical bars; the point estimates of OR for the 'garden' setting are shown by circles (-●-) and for the 'beach' setting by squares (-□-).

Logistic regression analyses indicated that some of the demographic and photosensitivity characteristics considered here are associated with protective measures adopted by the parents for their children. For example, the current study confirmed that photosensitive children are more carefully protected, which had also been reported in previous studies.[21,37] One interesting finding, however, invites speculation as to the underlying cause: younger mothers or fathers had their children wear a sunhat more often and used sunscreens more frequently. Does this mean younger parents also tend to use these measures for themselves? As we did not capture the parental sun-protection habits, we cannot provide empirical data to clarify this aspect.

The relationship between children's age and sun protection has been discussed in several earlier studies.[38] In general, children's own sun-protection knowledge increases with age,[39] while their sun-protection behaviour develops to the worse.[40,41] The latter observation is confirmed by the current study. Even for young children between 3 and 6 years of age we found a significant trend in reducing measures of sun protection with increasing age. Whether this trend is induced by a reduction in parental efforts to protect their older children, or by self-determined actions of older children paying less attention to parental guidance, cannot be answered by our data.

Further limitations of our investigation relate to the general problem of self-selection in population-based surveys and the problematic validity of self-administered questionnaires employed in such surveys. It can never be ruled out that the group of nonresponders, roughly one-third of the households with young children in our target population, behaves differently than the responding parents. Although our self-administered questionnaire had been used in two earlier surveys in another German city[25,26] and was extensively pretested during the preparation of the current study in Northern Bavaria,[42] we cannot be sure that all responders understood the items of the self-administered questionnaire as intended. The lack of information about socioeconomic status (SES) of responding

parents prohibits the opportunity to control for potentially confounding effects of SES which we have to acknowledge as a limitation of our analysis.

In conclusion, our findings may help to recognize potential targets of public health campaigns, such as encouragement of sun protection for children also in outdoor activities of daily living, not only during summer holidays at the seaside. The deficit of sun protection with increasing age of children is possibly even harder to tackle. It is unclear whether parents still represent the only relevant role model at an age of 6 years, or whether educational specialists involved in child care, or even the peer group itself, would be suitable target groups to increase knowledge, modify attitudes and eventually improve behaviour with regard to sun protection.

What's already known about this topic?

- Exposure to ultraviolet (UV) radiation is the main modifiable risk factor for skin cancer.
- Parental knowledge and awareness are critical for the protection of their children against harmful effects of UV exposure.

What does this study add?

- This is the first study comparing measures of sun protection for young children in different outdoor environments.
- There were significant differences in protective patterns between the environments: children were better protected in a holiday situation on the beach than during everyday outdoor activities.
- Better parental knowledge about risk factors for skin cancer improves protective behaviour only in the beach situation.
- Results confirm that sun protection of young children gets less intense with increasing age.

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