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Sun protective behaviour of primary and secondary school students in North-Western Switzerland

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Summary

BACKGROUND: The skin cancer incidence in Switzerland is one of the highest in Europe and still on the rise. Sun protection is the main preventive measure and of utmost importance during childhood and adolescence, since sunburns within these early phases of life increase the risk of developing skin cancer in adulthood.
OBJECTIVES: The aim of this prospective study, the first of its kind in Switzerland, was to investigate the sun protective behaviour of primary and secondary school students in Basel (North-Western Switzerland) and to test their knowledge about adverse health effects of solar radiation and about protective measures.
METHODS: Between March and April 2010, supervised classroom surveys during regular school lessons were conducted in 13 public schools using a multiple-choice questionnaire. 960 questionnaires were handed out to 48 school classes. Descriptive statistics and logistic regression analyses were performed on the data of 887 (>90%) students from three different grades (3rd, 6th and 9th grade).
RESULTS: Sun-related knowledge was high in one third of all respondents only and significantly depended on student's age and educational background. Although the oldest students reached the highest knowledge scores, they protected themselves the least from the sun. Sunscreen was the principal form of sun protection mentioned, but was insufficiently applied. Seeking shade and wearing clothing as protective measures were hardly used. High educational background (i.e., of the parents) was a determinant for routine use of sunscreen but was not associated with following other sun protective measures. The desire for a suntan had no impact on the use of sunscreen, but was a significant predictor for not seeking shade and wearing shoulderless shirts when in the sun. More than half of all study participants experienced at least one sunburn during the year preceding the survey. Fair skin type, higher grade, not seeking shade and wearing shoulderless shirts were directly associated with increased odds of sunburn. No association was found for the use of sunscreen and the occurrence of sunburn.
CONCLUSIONS: In order to reduce the incidence of skin cancer in Switzerland, it is essential to improve children's and adolescents' sun protective behaviour. Future skin cancer prevention campaigns should teach proper use of sunscreen, and emphasise the value of wearing clothing and seeking shade as the most effective sun protection. Furthermore, major efforts are needed to change adolescents' attitude towards a suntan.

Key words: *adolescents; children; knowledge; prevention; questionnaire; skin cancer; sunburn; sun protection; suntan*

Introduction

Switzerland has one of the highest skin cancer rates in Europe [1, 2]. On average, 2,000 persons are diagnosed annually with malignant melanoma, which represents the fourth most common potentially fatal cancer nationwide, and accounts around 2% of all cancer deaths [3, 4]. With an incidence of around 15,000 new cases per year, non-melanoma skin cancer (NMSC), in particular basal cell carcinoma and squamous cell carcinoma, is also the most common form of cancer and accounts for a third of all malignancies in Switzerland [2]. Although the mortality of NMSC is low, estimated annual hospitalisation costs related to NMSC are considerably higher than those related to malignant melanoma and are therefore of major public health relevance [5].
Skin cancer rates worldwide are on the rise [6]. Even though all underlying factors have yet to be completely understood, a population's increased sun exposure seems to play an essential role [7]. There is strong epidemiological

and biological evidence that most neoplasias of the skin are primarily induced by solar ultraviolet radiation (UVR) and are therefore highly preventable by adequate sun protection [7–9].

Since childhood and adolescence have been identified as key periods in the ethology of both malignant melanoma [10, 11] and NMSC [12, 13] in adulthood, sun protection is of utmost importance during these early phases of life. Hence, children and adolescents form a prominent target group for skin cancer prevention programmes. In addition, inducing sun protective behaviour in children may encourage appropriate sun protection practices throughout their lifetime [14].

In order to evaluate former prevention campaigns and to plan future interventions, various studies have been conducted over the last few decades to examine the sun protective behaviour of children and adolescents. The majority of these studies have been published in the USA and Australia.

Under the aegis of the Swiss Cancer League, skin cancer prevention campaigns have been carried out in Switzerland for more than 20 years [15]. Nevertheless, there has until now been hardly any investigation as to how well Swiss children and adolescents protect themselves from the sun, nor an examination of what they know about sun protection and the harmful effects of solar radiation.

It was the aim of this prospective study to investigate sun-related knowledge, attitudes and behaviour of primary and secondary school students in Basel (North-Western Switzerland).

Methods

Study population, sampling procedures

The study population consisted of school students attending the public school in Basel (North-Western Switzerland). For this study three different school years within compulsory schooling were selected: grades 3, 6 and 9. For further details see section definitions and classifications.

For logistical and organisational reasons, the selection of study participants could not be performed randomly. The Ministry of Education of the Canton Basel-Stadt assigned the participating schools. The classes within a school were assigned by the local school administration. The data were collected in a total of 48 school classes from 13 different schools between March and April 2010 using a written questionnaire. A letter about the survey previously informed parents. 960 questionnaires were handed out to the classes and completed during a regular school lesson under supervision of the class teacher. Where necessary, teachers were allowed to exemplify questions. Participation was on a voluntary basis. All students present in class on the day of the survey were included.

Questionnaire

The questionnaire was developed in German on the basis of the literature on foreign studies about children's and adolescents' sun protective behaviour and was optimised in collaboration with epidemiologists, psychologists and members of the Swiss Cancer League. The questionnaire which consisted almost exclusively of multiple choice items, was pilot tested with selected students of each age group and was slightly modified where necessary. Finally, the Ministry of Education and the Ministry of Health of the Canton Basel-Stadt approved the questionnaire.

Taking into account the age span of participants, two different questionnaires were created: one version for secondary school students (26 items) and another age-adjusted, abbreviated version for primary school students (21 items). For further details see section definitions and classifications.

Questions served essentially to assess (1.) students' knowledge about the adverse health effects of UVR and protective measures, (2.) their attitude towards a suntan, (3.) their self-reported sunburn history, (4.) their actual sun protective behaviour and (5.) the role of their parents regarding sun protection.

Definitions and classifications

Classification of education

According to the International Standard Classification of Education (ISCED) in the Canton Basel-Stadt the 3rd graders refer to ISCED level 1 and 6th and 9th graders to ISCED level 2. The average age of students was 9.0 (8–11) years in grade 3, 12.1 (11–14) years in grade 6 and 15.1 (14–17) years in grade 9. Due to national differences in grade allocation and for better tangibility the data will be discussed according to the above-mentioned grades – 3rd, 6th and 9th grade. In addition the term "primary school students" refers to 3rd graders and the term "secondary school students" to 6th and 9th graders.

Sunburn

Sunburn was defined as any reddening of the skin after exposure to the sun. It was emphasised that sunburn does not need to be painful.

Skin type

For self-assessment of skin type, the questionnaires contained a table with sample images in colour of the 6 skin types according to Fitzpatrick and the corresponding descriptions of skin, hair and eye colour as well as the ability to tan.

For further analysis, students were summarised in 3 groups: fair skin (skin type I&II), intermediately pigmented skin (skin type III & IV) and dark skin (skin type V & VI).

Parental education status

The parental education status was retrieved in the questionnaire and classified into (1) university degree (ISCED level 5A), (2) Matura (secondary school diploma) (ISCED level 3A), (3) apprenticeship (ISCED level 3C) and (4) no professional qualification.

For logistic regression analyses, university degree and Matura were summarised as "higher education".

In primary school students, the level of education was solely assessed by asking the children for the profession of their parents. Secondary school students could assign their parents additionally to one of the above-mentioned categories themselves.

Use of sunscreen

The use of sunscreen was defined as "routine", if students used sunscreen almost always or often on sunny summer days and "sporadic", if students used it only sometimes, rarely or never.

Knowledge

From the number of correctly answered knowledge items, a knowledge score was calculated (1 point for correct answers, no points for missing or incorrect answers).

Knowledge was classified as "high", "medium" or "low" according to the knowledge score obtained (see table 1).

Outcome variables and statistical analysis

Outcomes were defined as the occurrence of at least one sunburn (independent of the severity) and the occurrence of at least two painful sunburns, respectively, during the year preceding the survey. In addition, we studied attitude towards a suntan (desire for a suntan) as well as sunprotection behaviour (not using sunscreen, not seeking shade, and usually wearing clothing that does not cover upper arms and shoulders when in the sun).

For each outcome, a separate regression model was built.

Each returned and completed questionnaire was evaluated. Single missing or invalid answers were replaced with *"no data available"*. Depending on the model, gender, school year, skin type, parental education status, use of sunscreen, seeking shade, clothing, desire for a suntan and state of knowledge were examined as predictor variables. Only participants with complete data for all examined predictor variables were included in the regression analyses.

SAS 9.1 software (SAS Institute, Cary, NC) was used for all statistical analyses. Percentages were rounded to one decimal place and the sum total may not be 100. All data were examined for differences according to gender, skin type (sun sensitivity), grade and level of parental education using χ^2 test and Fisher's exact test, respectively, with $\alpha = 0.05$.

To evaluate the strength of associations between the outcomes studied and potential predictor variables, crude and adjusted odds ratios (OR) as well as the corresponding 95% confidence intervals (95% CI) were calculated performing univariate and multivariate logistic regression analyses. In the multivariate analysis, odds ratios were adjusted for all other variables in the model.

A crude power calculation was performed before the questionnaires were approved for questioning. The power calculation was based on the assumptions that some 30–50% of the children will be cases (i.e., had sunburn, did seek suntan), and – as consequence – some 50–70% of children will be controls. For the analyses on age and gender, the exposure prevalence is approx. 50% for analyses on gender, and 30% when exploring the role of age; assuming that age is stratified into three subgroups of similar size. Under these assumptions, the statistical power to detect an OR of 1.5 will be 70–80%, or 99% to detect an OR of 2.0 if starting with a sample size of 800–1,000 kids and defining statistical significance at the alpha-level of 0.05.

Results

Study population and demographics

Approximately 960 questionnaires were handed out to the classes and completed during a regular school lesson under supervision of the class teacher. A total of 887 (>90%) questionnaires were eligible for analysis. This represents approx. 20% of the pupils of all 3rd, 6th and 9th graders in the Canton-Basel-Stadt. No information is available on the missing questionnaires and the reasons for not returning them (absence or refusal).

Table 2 provides the characteristics of the study population. Gender distribution was consistent in all three grades ($p = 0.36$). Secondary school students reported a less sun sensitive skin type than primary school students ($p = 0.005$). Skin type distribution did not differ by gender ($p = 0.72$).

Knowledge

Knowledge about the adverse effects of excessive sun exposure and sun protection was high in 35.7% of all respondents. 31.0% achieved medium and 33.3% low knowledge scores only.

The state of knowledge was dependent on grade ($p < 0.0001$) and level of parental education ($p < 0.0001$). The older the students and the higher the parental education the better was the sun-related knowledge.

94.6% of 9th graders, 74.4% of 6th graders and 57.1% of 3rd graders claimed to have already known before this survey that UVR could cause skin cancer. In contrast, less than half of all study participants knew that UVR accelerates aging of the skin.

86.2% of secondary school students knew that one needs to protect oneself diligently from the sun when skiing or snowboarding, whilst 63.4% of primary school students were not aware that one could get sunburned when outside temperatures are low.

Among colour photographs of persons with different complexion (skin type II, III and V), 95.4% of 9th graders, 86.1% of 6th graders and 69.3% of 3rd graders correctly recognised the fair-skinned blonde girl (skin type II) as the person most susceptible to the sun.

80.5% of secondary school students thought it correct that the higher its sun protection factor (SPF) the better a sunscreen protects from the sun (8.2% considered this statement incorrect, 10.3% did not know and for the remaining 1% there is no data available).

The sunscreen illustrated with SPF 15 was rightly considered as suitable for an intermediately pigmented skin type (skin type III) by 68.8% of secondary school students whereas 12.5% falsely thought that it is suitable for fair,

Table 1: Classification of knowledge according to the knowledge score obtained.

Knowledge	Knowledge score Primary school students	Knowledge score Secondary school students
High	5–6 points	7–8 points
Medium	4 points	5–6 points
Low	0–3 points	0–4 points

sun sensitive skin (skin type I&II). 4.2% did not recognise any SPF on the sunscreen illustrated, 12.3% ticked the box "I don't know" and for the remaining 2.2% there is no data available.

A majority of 63% of all respondents reported their parents as main source of information on UVR and sun protection. In 3rd graders this proportion reached 79.8%, in fair-skinned students 72.2% and in children of parents having a university degree 74.6%. Further important sources of information were school lessons and skin cancer prevention campaigns, in particular for the older students and children and adolescents from families without academic background.

Attitude towards a suntan

One half (49.5%) of all participants reported that a suntan does not affect their good appearance, 33.9% preferred tanned skin, 7.1% found their untanned skin tone more attractive and the remaining 7.6% reported to have naturally dark skin (for 1.9% there is no data available).

The multivariate logistic regression analysis (see table 3) showed that tanned skin was statistically significantly more preferred by girls compared to boys, by 9th graders compared to 3rd graders, by intermediately pigmented subjects compared to fair-skinned subjects and by students who suffered from 2 or more painful sunburns during the year preceding the survey compared to those who had no sunburn during the same period.

25.7% of 6th graders and 38.4% of 9th graders stated that it was worth getting slightly burned to get a good tan (this question was not put to 3rd graders).

Sunburns

More than half (56.3%) of all respondents experienced at least one sunburn during the year preceding the survey (33.9% once, 16.6% twice and 5.8% 3 times or more).

Of these, 29.5% described their most serious sunburn as a non-painful reddening of the skin after sun exposure. In 61.5% the reddening was painful, and in 7.0% the skin blistered.

52.3% developed their most serious sunburn in the context of water sports, 19.6% by sunbathing, 15.2% by other outdoor activities, 4.8% by doing snow sports and 1.0% by working outside (the remaining participants did not answer the question).

In the multivariate analysis, higher grade, medium and particularly fair skin type as well as the regular wearing of shoulderless T-shirts were identified as independent predictors for the occurrence of at least 2 painful sunburns during the year preceding the survey (see table 4).

The odds ratios for the occurrence of at least one sunburn during the year preceding the survey were somewhat lower but showed the same ranges (data not shown). Not seeking shade was only a statistically significant determinant for the occurrence of one sunburn (for the occurrence of two painful sunburns, a similar odds ratio was calculated, but due to the small number of cases, statistical power was too low to reach significance).

The risk of severe sunburns was statistically significantly increased for female gender when not adjusted for clothing (OR 1.79, 95% CI 1.15–2.77), but when adjusted for clothing, the OR for female gender was no longer statistically significant (adj. OR 1.35, 95% CI 0.84–2.19). Owing to the strong correlation between female gender and the wearing of revealing clothing, female students can indirectly be described as a risk group for sunburn.

Parental education and the use of sunscreen had no impact on the occurrence of sunburn.

Sun protection

Use of sunscreen

On sunny summer days, 36.3% of all respondents used sunscreen almost always, 19.4% used it often, 24.9% sometimes and 18.2% rarely or never (no data available for 1.2%).

The multivariate logistic regression analysis (see table 5) showed that boys compared to girls, 6th graders and notably

Table 2: Characteristics of the study population.

Gender	**Absolute numbers (%)**
Male	436 (49.2)
Female	444 (50.1)
No data available	7 (0.8)
Total	887 (100)
Grade	**Absolute numbers (%)**
3 (average age 9.0 years)	287 (32.4)
6 (average age 12.1 years)	230 (25.9)
9 (average age 15.1 years)	370 (41.7)
Skin type	**Absolute numbers (%)**
Fair	194 (21.9)
Medium	591 (66.6)
Dark	90 (10.2)
No data available	12 (1.4)
Parental education status	**Absolute numbers (%)**
University degree	279 (31.5)
Matura	79 (8.9)
Apprenticeship	289 (32.6)
No professional qualification	155 (17.5)
No data available	85 (9.6)

9th graders compared to 3rd graders, dark-skinned students compared to fair-skinned students and children and adolescents whose parents completed an apprenticeship or had no professional qualification compared to students whose parents had a higher education were more likely to use sunscreen sporadically only (controls were routine sunscreen users).

We observed that low sun-related knowledge was associated with sporadic sunscreen use if the variable "grade" was included in the multivariate model.

Table 3: Multivariate logistic regression analysis for the preference for suntannend skin. Controls: Preference for untanned skin or no preference for either untanned or tanned skin.

	Preference for suntanned skin				
	Cases (n = 271)	Controls (n = 411)	OR	(95% CI)	p-value
Gender					
Male	115	215	1.00	Referent	
Female	156	196	1.41	(1.02–1.95)	0.04
Grade					
3	55	161	1.00	Referent	
6	60	110	1.42	(0.90–2.24)	0.13
9	156	140	2.67	(1.78–4.00)	<0.0001
Skin type					
Fair	50	127	1.00	Referent	
Medium	221	284	1.93	(1.30–2.86)	0.001
Parental education					
Higher education	133	184	1.00	Referent	
Apprenticeship	96	149	1.01	(0.70–1.45)	0.98
No qualification	42	78	0.78	(0.49–1.24)	0.29
Sunburn history*					
No sunburn	84	181	1.00	Referent	
1 or more sunburns free of pain or 1 painful sunburn	119	163	1.29	(0.89–1.87)	0.18
2 or more painful sunburns	68	67	1.82	(1.16–2.86)	0.01

* Period under consideration: 1 year preceding the survey
Only participants with complete data for all examined predictor variables were included in the regression analyses.

Table 4: Multivariate logistic regression analysis for the occurrence of at least 2 sunburns of medium severity (painful reddening of the skin) during the year preceding the survey. Controls: No sunburn within the relevant period.

	At least 2 painful sunburns during the year preceding the survey				
	Cases (n = 135)	Controls (n = 316)	OR	(95% CI)	p-value
Gender					
Male	54	171	1.00	Referent	
Female	81	145	1.35	(0.84–2.19)	0.22
Grade					
3	24	126	1.00	Referent	
6	34	85	2.73	(1.45–5.15)	0.002
9	77	105	4.10	(2.32–7.24)	<0.0001
Skin type					
Fair	45	69	11.86	(3.80–37.01)	<0.0001
Medium	86	197	6.22	(2.09–18.50)	0.001
Dark	4	50	1.00	Referent	
Parental education					
Higher education	66	146	1.00	Referent	
Apprenticeship	44	112	1.03	(0.62–1.70)	0.91
No qualification	25	58	1.11	(0.60–2.07)	0.74
Use of sunscreen					
Routine	69	179	1.00	Referent	
Sporadic	66	137	1.21	(0.77–1.93)	0.41
Seeking shade					
Yes	39	127	1.00	Referent	
No	96	189	1.40	(0.86–2.26)	0.18
Clothing					
Typically shoulder-covering shirts	55	187	1.00	Referent	
Typically shoulderless shirts	32	37	2.45	(1.26–4.76)	0.008
The both above to the same extent	48	92	1.73	(1.02–2.94)	0.04

Only participants with complete data for all examined predictor variables were included in the regression analyses.

The desire for a suntan had no impact on the use of sunscreen.

Approximately half (49.3%) of secondary school students who used sunscreen at least sometimes applied it only once in the morning. 34.9% repeated the application several times a day as recommended (the remaining 15.8% did not answer the question). Girls more often reapplied the sunscreen than boys (44.2% vs. 24.3%; p <0.0001) and fair-skinned students did so more often than intermediately pigmented and dark-skinned students, respectively (50.5% vs. 32.1% and 23.8%, respectively; p = 0.006).

After swimming, 43.7% of secondary school students who used sunscreen at least sometimes reapplied the sun protection product whereas 43.5% did not (no data available for the remaining 12.8%).

Of the secondary school students using sunscreen at least sometimes, 56.3% usually used a product with SPF ≥20, 13.5% a product with SPF <20, 13.3% did not know and 17.0% did not make a statement. The higher the parental education status and the lighter the skin the higher was the percentage of students who used a sunscreen with high SPF.

Seeking shade

Only about a third (32.2%) of all respondents reported seeking shade in summer whenever possible. In contrast, nearly two thirds (66.1%) reported seeking shade only if temperatures in the sun are uncomfortably high (no data available for the remaining 1.7%).

According to the multivariate model (n_{cases} = 514; $n_{controls}$ = 248; variables studied: gender, grade, skin type, parental education status, desire for a suntan, knowledge), intermediately pigmented participants compared to fair skinned participants (OR: 1.73; 95% CI: 1.19–2.51; p = 0.004) and participants with preference for tanned skin compared to participants with preference for untanned skin or no preference for either tanned or untanned skin (OR: 2.34; CI: 1.61–3.39; p <0.0001) were more likely not to seek shade unless temperatures become uncomfortable in the sun (controls were shade-seeking participants). The other variables in the model had no significant impact on shade seeking behaviour.

Clothing

Half (49.9%) of all respondents reported regularly wearing a T-shirt covering the shoulders on sunny summer days. 15.2% usually wore a shoulderless shirt and 33.0% shoulder-covering and shoulderless shirts with similar frequencies, respectively (no data available for the remaining 1.8%).

The multivariate analysis (n_{cases} = 115; $n_{controls}$ = 386; variables studied: gender, grade, skin type, parental education status, desire for a suntan) showed that female gender compared to male gender (OR: 13.3; 95% CI: 7.45-23.84; p <0.0001), grade 9 compared to grade 3 (OR: 2.86; 95% CI: 1.52-5.40; p = 0.001) and preference for tanned skin compared to preference for untanned skin or no preference for either tanned or untanned skin (OR: 2.55; 95% CI: 1.49–4.38; p <0.001) were strongly associated with the usual wearing of shoulderless shirts (controls were participants who regularly wore shoulder-covering shirts).

Furthermore, only 36.8% of secondary school students stated sometimes wearing a shoulder-covering shirt deliberately as sun protection.

Table 5: Multivariate logistic regression analysis for sporadic use of sunscreen. Controls: Routine use of sunscreen.

	Sporadic use of sunscreen				
	Cases (n = 343)	Controls (n = 423)	OR	(95% CI)	p-value
Gender					
Male	183	192	1.00	Referent	
Female	160	231	0.68	(0.50–0.93)	0.01
Grade					
3	78	164	1.00	Referent	
6	84	110	1.75	(1.14–2.67)	0.01
9	181	149	4.00	(2.57–6.21)	<0.0001
Skin type					
Fair	59	116	1.00	Referent	
Medium	233	282	1.32	(0.90–1.93)	0.15
Dark	51	25	2.45	(1.19–5.06)	0.02
Parental education					
Higher education	128	216	1.00	Referent	
Apprenticeship	129	147	1.66	(1.17–2.37)	0.005
No qualification	86	60	2.57	(1.65–4.00)	<0.0001
Desire for a suntan					
Preference for tanned skin	120	152	0.96	(0.69–1.35)	0.83
No preference or preference for untanned skin	180	256	1.00	Referent	
Naturally dark skin	43	15	1.86	(0.85–4.06)	0.12
Knowledge					
High	117	166	1.00	Referent	
Medium	120	124	1.67	(1.12–2.48)	0.01
Low	106	133	1.69	(1.07–2.67)	0.02
Only participants with complete data for all examined predictor variables were included in the regression analyses.					

Role of the parents

52.5% of secondary school students reported that sun protection was a topic of conversation at home and that they are continuously prompted by their parents to protect themselves from the sun. 18.5% were informed by their parents as well, but the parents did not (or not anymore) interfere actively in their sun protective behaviour. In 15.8%, sun protection was only marginally discussed at home and in 9.0% the topic never came up at all (4.2% did not give any statement).

In families with lower educational background, sun protection was less of a topic of conversation than in families with a higher educational background ($p < 0.0001$).

Sporadic sunscreen users were nearly 3 times as likely as routine sunscreen users to live in a family where sun protection was rarely or never discussed than in a family where sun protection was an issue of interest (OR: 2.83; 95% CI: 1.79–4.47; $p < 0.0001$; adjusted for gender, skin type, parental education status, knowledge and seeking shade).

In 41.1% of primary school students, sunscreen was mostly applied by the parents (in 51.4% of children of parents with a university degree, in 41.7% of children of parents with an apprenticeship and in 23.6% of children of parents with no professional qualification). 27.2% were reminded by their parents to use sunscreen, but applied it on their own (furthermore, 22.7% stated that sunscreen was applied both by their parents and by themselves).

18.8% of the children were prompted by their parents to seek shade and 33.1% were encouraged to wear a T-shirt for sun protection when swimming or playing outside. 2.4% reported that sun protection is their own business and the parents do not intervene.

Discussion

The present survey – the first of its kind in Switzerland – focuses on the investigation of sun protective behaviour in children and adolescents.

The assessed knowledge about UVR and sun protection of the primary and secondary school students surveyed shows that in some respects, there is still considerable potential for sun-related education. Although the oldest students achieved the highest knowledge scores, they protected themselves the least from the sun compared with the younger study participants. This observation has also been made by others [14, 16–20]. On the other hand, it is encouraging for future skin cancer prevention campaigns targeting adolescents that high knowledge was associated with routine use of sunscreen when 9th graders were analysed separately.

In the population studied, all sun protective measures were generally underused. Sunscreen was the principal form of sun protection mentioned, albeit often not properly applied. Only a minority of participants reported seeking shade and wearing skin-covering clothing deliberately as sun protection. Moreover, everyday clothing was quite revealing, particularly in girls, and not conducive to sun protection. But specifically the omission of seeking shade or wearing skin-covering clothing was associated with increased sunburn risk, whilst the use of sunscreen had no direct impact on the number of sunburns suffered during the defined time period.

The lack of a positive effect of routine sunscreen use on the likelihood of being sunburned has been reported in the literature [16, 17, 21–24]. After excluding high sun sensitivity as potential confounder, this phenomenon can partly be explained by the correlation of sunscreen use and sun exposure. Furthermore, it has been documented that the presumed protection of sunscreens induces people to stay in the sun longer when sun exposure is intentional [25]. This is especially problematic, since in practice most consumers apply only a fractional amount of the sunscreen quantity used for assessing the SPF in test laboratories and consequently do not benefit from the SPF indicated on the product [26].

In this context, it is also not surprising that participants with a liking for tanned skin used sunscreen as often as participants who did not strive for a tan but less frequently sought shade and more often wore revealing clothing enabling shoulders and upper arms to tan.

The use of sunscreen was the only sun protective measure influenced by the educational background. The fact, that children and adolescents of families with little schooling used less sunscreen than those from more educated families is probably a consequence of little health awareness and higher risk behaviour in lower social classes [27]. The costs of sun protection products may present an additional barrier.

Overall, along with sun-related knowledge, sun protective behaviour depends to a large extent on further factors such as the desire for a suntan, attitudes and behaviour of peers and a general high willingness to take health risks. Whereas gaps in knowledge can be easily compensated for by the parents of younger children, it is considerably more difficult to influence other factors mentioned, which become increasingly important with the advent of puberty.

However, according to the multivariate model, the increased number of sunburns in 6th graders and particularly in 9th graders compared to 3rd graders can only partly be explained by the less appropriate sun protection in older students. We suggest that additional factors not assessed in our study may contribute to the increased occurrence of sunburn in older age groups, notably the level of sun exposure. Differently spent leisure time may result in higher sun exposure levels in adolescents than in children. Many recreational activities entailing high exposure to the sun such as various team sports, jogging and biking gain in popularity during adolescence. In this context, sunbathing as a recreational activity per se should not be ignored.

It can be said that sun protection is of special importance during adolescence, but this age group in particular is the most difficult to access for skin cancer prevention. Therefore, it is vital to establish sun protective measures as a matter of course before puberty is reached. Such patterns of behaviour learnt in early childhood can be maintained in adolescence, at least in part, as is shown by the fact that the secondary school students surveyed protected themselves better from the sun if they grew up in families who emphasise the importance of sun protection. This underlines the need to involve parents in skin cancer prevention measures for their children.

When interpreting the findings of this study, some limitations may apply.

For logistical and organisational reasons, the selection of study participants could not be performed randomly. Nevertheless, it is assumed that primary and secondary school students of Basel are well represented by the present sample (approx. 20% of the pupils of all 3rd, 6th and 9th graders in the Canton-Basel-Stadt), which includes students of different social classes attending schools in various parts of town.

The data collected represents the attitudes and behaviour of an urban population in German-speaking Switzerland and cannot directly be transferred to the population of rural regions and other parts of Switzerland, respectively.

The complete dataset is based on self-report by study participants and therefore may be subject to social desirability and recall bias. However, the results of previous studies suggest that self-report as a way of assessing sun protection practices is generally valid [28] and, concerning its reliability, appears to be as good as objective measures [29].

Conclusion

In order to reduce the incidence of skin cancer in Switzerland, it is essential to improve children's and adolescents' sun protective behaviour. Although knowledge and behaviour do not correlate in every respect, knowledge about the potential long-term consequences of excessive sun exposure and the recommendations for appropriate sun protection is a fundamental prerequisite to further improving sun protective behaviour.

Within the scope of future skin cancer prevention campaigns it should be emphasised that shade and covering clothing provide the most effective protection from the sun. The limitations of sunscreen use should be stated.

Furthermore, interventions are needed which aim to change adolescents' attitude towards tanned skin and clarify that suntan is not healthy per se.

Prevention campaigns should ideally be aimed at twelve to fourteen year-old adolescents, because at this age the desire for a suntan becomes more important, sun protective behaviour fades and the number of sunburns increases. Younger children up to and including primary school age should be targeted via their parents.

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Appendix

Questionnaires for primary and secondary school students are provided in the appendix.

Figures (large format)

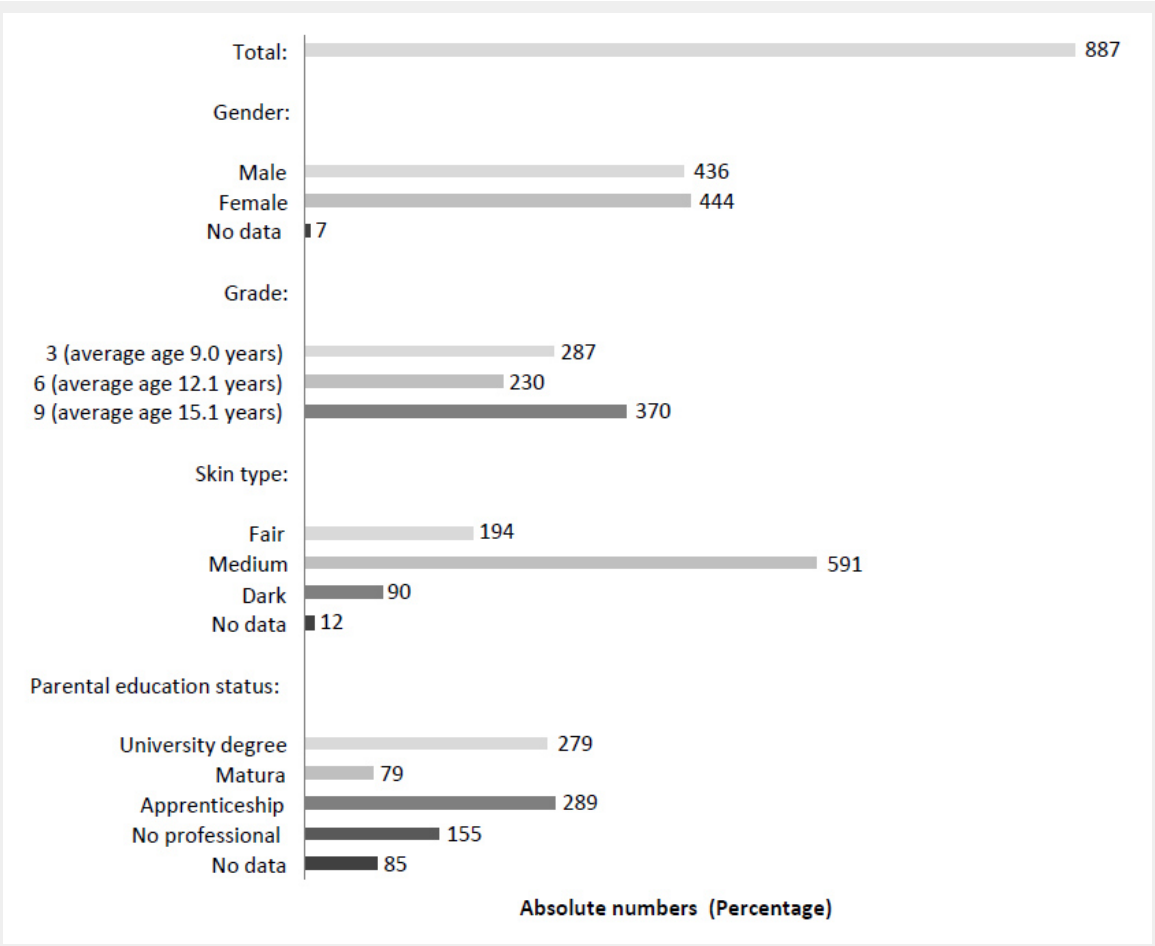

Figure 1

Characteristics of the study population.