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Ultraviolet radiation protection and skin cancer awareness in recreational athletes: a survey among participants in a running event

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Summary

PRINCIPLE: Ultraviolet radiation (UVR) protection and skin cancer awareness are essential in the avoidance of cutaneous malignancies. Skin cancer prevention programmes involve public educational campaigns, for example, for outdoor workers or school children. Since nonprofessional sun exposure (e.g. during outdoor sport) is increasing with today's lifestyle, we assessed UVR protection and skin cancer awareness among recreational athletes.

This survey-based, paper/pencil study was designed to assess UVR protection and skin cancer awareness among recreational athletes attending the largest running event in Switzerland.

METHODS: All adults (age 18 and older) attending this run were invited to complete our survey at our study booth. Our form consisted of questions about participants' personal characteristics such as age, gender, educational attainment, skin type, history of sunburns, and personal/family history of skin cancer, as well as participants' subjective attitudes and behaviours relating to UVR protection and skin cancer avoidance. We calculated separate scores for individual UVR protection and skin cancer awareness. We tested these two scores in relation to educational level as a primary endpoint. In addition, the impacts of further distinct characteristics were assessed in multivariable analysis.

RESULTS: A total of 970 runners (457 males, 513 females, mean age 41.0 years) completed our survey. Our results indicate that UVR protection is dependent on age, gender, skin type and personal history of skin cancer. Educational attainment (at univariate level), age, gender and skin type (in multivariable analysis) significantly affected the skin cancer awareness score.

CONCLUSION: Our findings suggest that protection measures among recreational sportsmen can be improved. Achievements are notable in older, fair skinned, female runners. Our findings indicate that further work is needed in the education of the general public, and athletes in particular.

Key words: *skin cancer; epidemiology; ultraviolet protection; awareness; sport; running*

Introduction

The incidence of skin cancers in Europe is steadily increasing. Switzerland, together with the Scandinavian countries, shows the highest melanoma rate in the general European population [1]. Ultraviolet (UV) radiation (UVR) is the most important avoidable risk factor for the development of nonmelanoma skin cancer (NMSC) and of melanoma [2]. Protective measures and being aware of skin cancer were shown to be effective in avoiding harmful effects of UVR and thereby in preventing skin cancer [3–7]. General UVR protection behaviours include avoiding exposure to sunlight, wearing suitable clothing (e.g. long sleeved, UVR resistant shirts and trousers), a cap (preferably with ear/neck flaps) and sunglasses, as well as application of potent sunscreen on uncovered body parts.

Besides occupations that involve working outside [8–11], recreational outdoor activities [12–14], such as skiing [15–17], swimming [18, 19], cycling [20] or running [21, 22] are gaining increasing importance in the exposure of the population to UVR. These hobbies result in a high cumulative as well as intermittent sun light exposure rate [18], both contributing to the development of NMSC [23] and melanoma [24].

Our study was performed at the Grand Prix of Bern, the largest running event in Switzerland with over 25 000 participants (aged 5–90 years) in various categories and race lengths (adults from 5 km "old town loop" to 10 miles "bigger city loop") [25]. Participants encompass internationally known professionals as well as children having their first running experience. We were mainly interested in recreational adult runners.

To gain insight into the factors affecting UVR protection behaviour and skin cancer awareness in recreational athletes in Switzerland, we conducted a questionnaire-based study.

Higher educational level is associated with better protection against UVR [26–31]. Our hypothesis was that runners with a higher level of education have a greater knowledge about the harmful effects of sunlight. They should use higher UVR protection and should be more aware of skin cancer: Therefore, the primary endpoint of our study was the influence of educational attainment on the two scores. The secondary endpoint was the impact of other sociodemographic factors on the scores. By identifying factors significantly affecting UVR protection and skin cancer awareness, we expected to gain generally applicable information to improve and better focus preventive campaigns.

Materials and methods

Participants

This survey-based study was conducted at the exhibition site of the Grand Prix of Bern, which took place 18 May 2013. The weather on this day was lightly overcast; the temperature was about 25 degrees Celsius. In a postal leaflet sent out by the organisers of the race to each registered runner, the presence of several companies and nonprofit organisations, including our university hospital, was stated. We did not send out an additional letter informing participants about our study. Our study booth was at the entrance of the exhibition hall where all nonprofessional runners had to pass in order to collect their race number for identification purposes on the eve of the run (May 17). A group from the authors and voluntary helpers asked all passing runners personally to contribute to our survey. The number of addressed but not participating runners was estimated to be about 4000. This was probably due to lack of interest or time.

Every adult (18 years and older nonprofessional runner, of either gender, who was willing to participate in the study was included. The local Ethics Committee of the University of Bern approved this study.

Questionnaire

We developed the questionnaire in German language (see English translation in the appendix). Except for the study subjects' characteristics, the form consisted of multiple-choice questions. The questions were self-assessed by the athletes. For information and support a board-certified dermatologist (P.A.O.) was on site. For the assessment of individual skin type, sample pictures of Fitzpatrick skin types I–VI [32] with a short description of their characteristics were shown.

The questions were assigned to three different parts. The first part comprised seven questions gathering basic information about individual characteristics such as gender, age and educational attainment. Questions addressing factors known to correlate with a high risk of skin cancer development, namely the skin type, sunburn frequency before adulthood, and personal and family history of skin cancer, were also included in this part. The second part, which acquired information about UVR protection behaviour, consisted of eight questions, including the use of sunscreen during jogging or training (Our question [Q]: Do you use sunscreen when you go running? Possible answers [A]: Always, sometimes, never), the type of clothing used while running on a sunny day (Q: What kind of top do you wear for training on a hot sunny day? A: More often a short sleeved T-shirt, more often a tank top, both about equally frequent), the frequency of sunscreen application during outdoor activities that last longer than one hour (Q: Do you reapply sunscreen when you are outside for more than an hour? A: Never, sometimes, always), the grade of sun protection factor (SPF) used during outdoor activities lasting longer than one hour on the face and on the body (Q: What SPF are you using when you are outside for more than an hour a) on the face b) on the body? A: None, <25, 26–50, >50), reapplication of sunscreen during longer training sessions, discussion about sun protection issues with the training partner, use of solariums and frequency of consultations with dermatologists. The last part of the questionnaire, with three questions, was designed to investigate the awareness of the athletes regarding the risks of UVR and the behavioural patterns promoting the development of skin cancer. It covered questions related to the feelings provoked by either suntanned skin or by UVR-risk awareness campaigns in the population as well as consumer expectations of sunscreens regarding waterproofness, sweat resistance and galenics.

Ranking system

To correlate the participating athletes' characteristics with their UVR protection behaviour and with their skin cancer awareness, a ranking system was developed. This system consisted of defined numbers of points per question (e.g., Do you use sunscreen when you go running? Never = 1 point, sometimes = 2 points, always = 3 points). The points attributed to each question provided an adequate weighting of each question. Summarising all points an individual obtained (a higher number of points reflects higher scores) resulted in two scores: first, the UVR prevention score and secondly, the skin cancer awareness score.

For questions involving the UVR prevention score, only questionnaires missing not more than one answer were used for analysis. In the event of a missing answer, the value of the item was zero, implying that the subject was highly unlikely to use any sun protection measure.

The skin cancer awareness score was calculated under the assumption that at least two out of three questions were answered completely. These two questions addressed the frequency of consultations with dermatologists and the perception of tanned skin. The question regarding different attributes of sunscreen was weighted less. If any answer concerning sunscreen characteristics were missing, the amount of points obtained for each sub-question was set to zero, assuming that the athlete had no awareness of the specific topic.

Statistical analysis

For descriptive purposes, data were presented as means with standard deviations (SD) or numbers with percentages for continuous and categorical variables, respectively.

For the univariate analysis of the primary endpoint standard statistical methods involving the Kruskal-Wallis-test were used. In the case of significance, Cuzick's test for trend across different levels of the variable was also per-

formed. In order to analyse the educational attainment of the participants, four different subcategories according to the Swiss educational system were made: namely university degree, school of applied science, apprenticeship and basic education.

We then performed a multivariable analysis including other factors of interest. These were gender, age, skin type, sunburn frequency, and personal and family history of skin cancer. The effects of selected factors on the two scores were expressed in terms of standardised correlation coefficients (r) along with 95% confidence intervals (CI) and p-values. Multiple linear regression was used to adjust factors for potential confounders (in our study age and gender). Absence of multi-collinearity and normal distribution assumption of the residuals were checked by using variance inflation factor (VIF) and QQ plots, respectively. All tests were considered significant at p-value <0.05. The analysis was carried out using SPSS software, version 17.0 (SPSS, Chicago, IL, USA).

Results

Study population

In total, 970 runners participated in our study (table 1). Of these, 52.9% were females and the mean age was 41.0 ± 13.5 years. In regard to the educational attainment, most subjects had done an apprenticeship (38.4%) or attended a school of applied science (32.7%). The most common Fitzpatrick skin type was III (53.2%). Overall, 34.4% of subjects reported one or more heavy sunburns before adulthood and 3.9% a personal history of skin cancer. A family history of skin cancer was also reported by 14.9% of participants.

Some questionnaires were not filled out completely. Since some missing answers in the questionnaires affected only either the UVR protection score or the skin cancer awareness score, two distinct procedures analysing the data were undertaken.

After exclusions, the UVR protection and the skin cancer awareness score were computable for 935 and 913 questionnaires, respectively.

Educational attainment and the UVR protection and skin cancer awareness scores

We analysed the correlation between the UVR protection score and educational attainment based on 914 observations. The obtained p-value of 0.24 was not significant. Next, we correlated the skin cancer awareness score with educational attainment based on 894 observations. The test was statistically significant with a p-value of 0.01. A significant trend of increasing values of the score with lower educational levels was observed (p-value = 0.02). Results are shown in box plots (fig. 1).

Multivariable analysis

Results of the multivariable analysis are reported in table 2. The analysis showed that female gender, age of 25 years or more, Fitzpatrick skin type <IV and personal history of skin cancer were all factors associated with the UVR prevention score (fig. 2). Factors with most impact on the score were age between 35 and 54 years (r = 0.29; 95% CI 0.20–0.39) or over (r = 0.31; 95% CI 0.22–0.40) and a skin type of I–II (r = 0.33; 95% CI 0.25–0.40).

The analysis of the skin cancer awareness score revealed similar associations: female gender, age of 35 years or more and skin type <IV were all independent factors predicting the outcome (fig. 3). The variable most influencing the score was age between 35 and 54 years (r = 0.27; 95% CI 0.17–0.37).

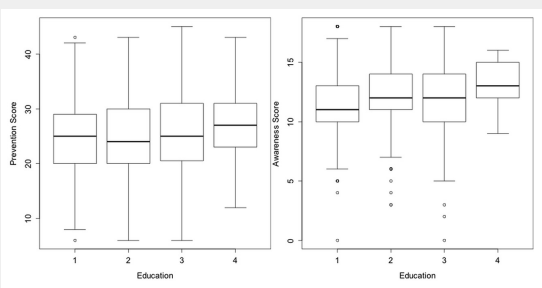

Figure 1

Box plots of the ultraviolet radiation prevention and the skin cancer awareness scores and the educational attainment of the participants, univariate level.

The correlation between the UVR prevention score and educational attainment was not significant (p = 0.24). Educational attainment was significantly associated with the awareness score at univariate level only (p = 0.01). 1 is the highest and 4 the lowest educational level. The educational attainment of the participants was grouped into four different subcategories according to the Swiss educational system: (1) university degree, (2) school of applied science, (3) apprenticeship, and (4) basic education.

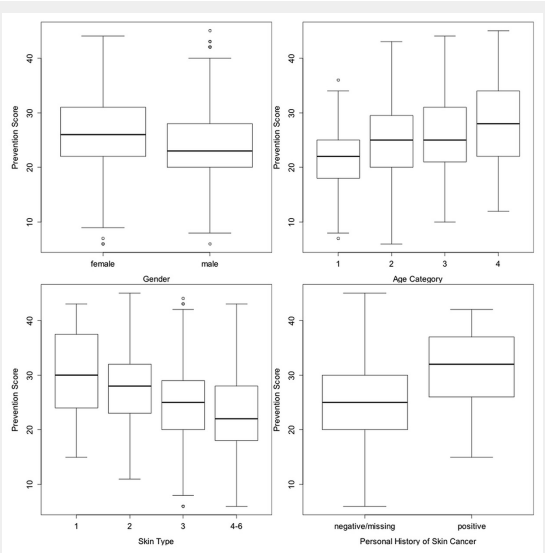

Figure 2

Box plots of the ultraviolet radiation prevention score and gender, age category, skin type and personal history of skin cancer of the participants, univariate level.

The correlation between the UVR prevention score and gender, age category, skin type, and personal history of skin cancer were statistically significant (for individual p-values refer to table 2).

Four age categories were made, based on the year of birth of the athletes: Category 1 (18–24 years), category 2 (25–34 years), category 3 (35–54 years) and category 4 (≥55 years). The skin type was divided into four different groups: category 1 (Fitzpatrick skin type I), category 2 (Fitzpatrick skin type II), category 3 (Fitzpatrick skin type III) and category 4 (Fitzpatrick skin type IV–VI).

Educational attainment was not significant in multivariable analysis. This was a result of the significant correlation between educational level and both age and gender, which acted as confounding factors (data not shown).

Discussion

The incidence of skin cancers, and especially NMSC, has increased during the last few decades [33]. Incidence projections for the future showed no signs of plateauing [34]. One reason for the great increase in NMSC incidence might be changes in medical practice such as earlier detection and NMSC being more often diagnosed histologically. Nevertheless changes in lifestyle and UVR exposure likely represent the main causes for these findings [35].

The results obtained in this study show that older, fair-skinned, female athletes have a higher UVR protection behaviour and skin cancer awareness when compared with the average participant of the running event. This is comparable with other recent studies from New Zealand and Sweden [27, 36].

Table 1: Summarised demographic data of the respondents.

		N*	%
Total		970	100.0%
Gender	Male	457	47.1%
	Female	513	52.9%
Age (mean, SD)		*41.0*	*13.5%*
	<25	118	12.2%
	25–34	222	23.0%
	35–54	472	48.9%
	≥55	154	15.9%
Educational attainment	University degree	253	26.7%
	School of applied science	310	32.7%
	Apprenticeship	364	38.4%
	Basic education	21	2.2%
Skin Type	I	45	4.7%
	II	215	22.4%
	III	511	53.2%
	IV–VI	190	19.8%
Heavy sunburns before adulthood	None / don't remember / missing	636	65.6%
	One or more	334	34.4%
Personal history of skin cancer	Negative/missing	932	96.1%
	Positive	38	3.9%
Family history of skin cancer	Negative/missing Positive	825 145	85.1% 14.9%

* Numbers may not add up to the total because of missing data

Table 2: Multivariable analysis of factors associated with ultraviolet radiation (UVR) prevention and skin cancer awareness scores.

		UVR prevention score		Skin cancer awareness score	
		r (95% CI)*	p-value	r (95% CI)*	p-value
Gender	Male†	–		–	
	Female	0.18 (0.12, 0.24)	<0.001	0.10 (0.04, 0.17)	0.002
Age	<25†	–		–	
	25–34	0.19 (0.10, 0.28)	<0.001	0.05 (–0.05, 0.14)	0.33
	35–54	0.29 (0.20, 0.39)	<0.001	0.27 (0.17, 0.37)	<0.001
	≥55	0.31 (0.22, 0.40)	<0.001	0.14 (0.05, 0.23)	0.002
Educational attainment	University degree†	–		–	
	School of applied science	0.02 (–0.05, 0.10)	0.58	0.07 (0, 0.15)	0.06
	Apprenticeship	0.02 (–0.06, 0.10)	0.62	0.01 (–0.07, 0.09)	0.83
	Basic education	0.02 (–0.04, 0.09)	0.46	0.05 (–0.01, 0.12)	0.11
Skin Type	I–II	0.33 (0.25, 0.40)	<0.001	0.12 (0.04, 0.21)	0.004
	III	0.15 (0.07, 0.23)	<0.001	0.12 (0.04, 0.21)	0.005
	IV–VI†	–		–	
Heavy sunburns before adulthood	None / don't remember / missing†	–		–	
	One or more	0.05 (-0.01, 0.12)	0.08	0.03 (–0.03, 0.09)	0.36
Personal history of skin cancer	Negative/missing†	–		–	
	Positive	0.14 (0.08, 0.20)	<0.001	0.02 (–0.05, 0.08)	0.58
Family history of skin cancer	Negative/missing† Positive	– 0.03 (–0.03, 0.09)	0.30	– 0.00 (–0.07, 0.06)	0.87

CI = confidence interval; r = standardised correlation coefficient

* Multiple linear regression analysis estimates including terms for age and gender.

† Reference category

Surprisingly, at first glance the athletes with the lowest education level (basic education) had the highest skin cancer awareness score. Studies from the USA have showed that people with a higher degree of education have a higher incidence rate of melanoma [37].

When planning this study we estimated that, with a sample of at least 900 subjects, we would be able to detect standardised correlation coefficients of 0.094 or more with adjustment for two other covariates ($\alpha = 0.05$, $\beta = 0.20$), corresponding to a small effect size according to Cohen's guidelines [38]. This confirms that the observed lack of effect regarding educational attainment cannot be attributed to insufficient power in the multivariable analysis.

However, in our study this finding was not confirmed in multivariable analysis, since other significant factors, such as age and gender, were associated with educational level and acted as confounders. Concerning this matter, choosing to measure educational attainment as the primary endpoint implies a rather simplified understanding of social factors that are relevant for daily life behaviour. The categorisation of different educational levels might be of relevance in young people who have just finished their education. It seems doubtful that educational attainment is still of primary interest in people of 50 years and older. At this age other factors could be of much greater relevance and should have been taken into account; for example, to what extend does personal revenue and/or profession influence UVR protection and skin cancer awareness.

In Switzerland, the incidence of melanoma is higher for women than for men. This observation is supported by the notion that women are thought to have a stronger desire to be suntanned [39]. On the other hand, with regard to sun protective behaviour, women have been reported to apply skin care products more frequently than men [14, 39, 40]. Our findings indicate that female athletes have a slightly higher UVR protection and skin cancer awareness score than their male colleagues.

The impact of the different age groups on the UVR protection score was almost linear. The UVR protection score showed an increase in a stepwise fashion for each category from the youngest (18–24 years) to the oldest group (55 years or over). With regard to the skin cancer awareness score, there was a clear cut-off between the athletes younger than 35 years and those of 35 years old or over, as the two lowest age categories and the two highest categories displayed almost identical box plots. The two categories of participants aged 35 years and older both had a higher awareness score than the two categories in the younger age group. In this context, our findings are in line with those found in a telephone survey study about sun protection knowledge in the Bavarian population. In this, young men were found to be the least informed [41]. It is likely that middle-aged and elderly people are more conscious of, and concerned about, their health. They may be more frequently faced with personal illness and they may more often have contact with people suffering from diseases such as skin cancer. It is possible that this renders them more receptive to prevention measures [42]. Since young outdoor sport competitors are at high risk for excessive sun exposure, it is important that future health campaigns focus on this group to improve their knowledge about UVR protection behaviour and skin cancer awareness [43].

Based on the obtained UVR protection score, adult athletes with the fairest skin seem to protect themselves better than darker skinned subjects. The median score for each skin type group decreases in a continuous manner from types I and II to type VI. Since the skin type categories IV to VI have already a naturally lower risk of developing skin cancer, our study confirms that campaign efforts should be focused on the enhancement of the protection behaviour in subjects with fairer skin types, i.e., skin types I and II.

The skin cancer awareness scores were similar among the categories of skin type I, II and III. The athletes in skin type IV–VI categories showed a significantly lower skin cancer awareness score. It is a common misconception that darker skinned people do not need sun protection at all. This observation may provide the rationale for further improvement of the UVR protection measures [44]. A recent Californian study [45] has highlighted the reasons for racial/ethnic differences in sunscreen use. Mahler et al. showed the need for creating awareness in races/ethnicities other than Caucasians. Notably, recent studies have shown that darker skinned people show higher melanoma- [46, 47] and NMSC- [46] related mortality as a result of delayed initial diagnosis with patients therefore often displaying more advanced stages.

The athletes with a positive personal history of skin cancer were found to have a higher UVR protection score. One has to assume that these subjects are more alert to sun protective measures, since this health issue directly affects them. In contrast, there was no significant correlation between positive family history of skin cancer and the UVR preven-

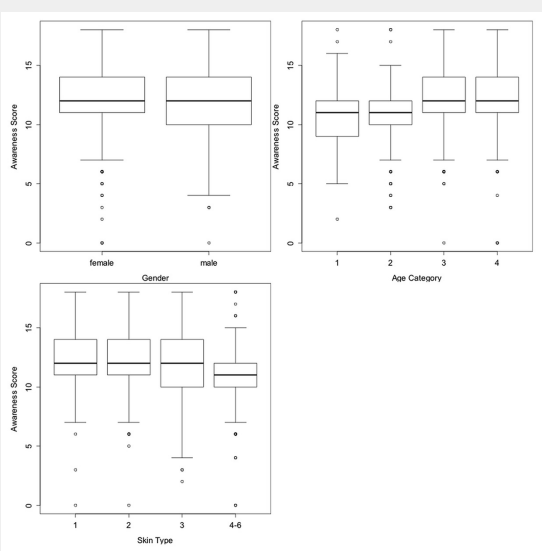

Figure 3

Box plots of the skin cancer awareness score and the gender, the age category and the skin type of the participants, univariate level. The correlation between the skin cancer awareness score and gender, age category, and skin type were statistically significant (for individual p-values refer to table 2).

Four age categories were made, based on the year of birth of the athletes: category 1 (18–24 years), category 2 (25–34 years), category 3 (35–54 years) and category 4 (≥55 years). The skin type was divided into four different groups: Category 1 (Fitzpatrick skin type I), category 2 (Fitzpatrick skin type II), category 3 (Fitzpatrick skin type III) and category 4 (Fitzpatrick skin type IV–VI).

tion score. This shows that athletes who are not personally affected by skin cancer are less concerned about UVR protection.

Our study had some limitations. The term "Personal and family history of skin cancer" was probably not sufficiently explained in the questionnaire: a better description of melanoma and nonmelanoma skin cancers in the personal and family history should have been provided. All skin cancers in relatives, whether of first degree or more distant (e.g. uncles) were counted. In addition, only about 4% of all runners participated in our survey. This was partly owing to logistics (not enough interviewers), as we were not able to recruit more runners on the exhibition site. Most participants were only interested in running and did not want to spend time completing a survey. Furthermore, only a part of all the athletes personally addressed (estimated around 4000) at our study booth were willing to participate in our survey. This is probably a result of a lack of interest and/or time of some runners. These later two points taken together, our data might not be as representative as they may look at a first glance. Our study demonstrated another potential for selection bias associated with the non-randomised nature of the sample: it is possible that subjects with a positive personal or familial history of skin cancer were more likely to fill out our questionnaire. Nevertheless, if a high concern about skin cancer has a positive impact on the selection of the athletes included in the study, such a bias would have likely influenced responses toward a higher level of sun protection habits and skin cancer awareness. Hence, the situation might be even worse than as depicted by our study. On the other hand, only positive personal history and not positive familial history of skin cancer showed a significant correlation with improved UVR protection.

Offering three levels of answers to the participants might not have been appropriate, since it has been shown that people often take the middle option by default. Four possible modalities may have led to different and/or statistically sounder results.

Finally, our survey was conducted in German, thereby selecting only German-speaking runners. Providing the questionnaire in French, English or other languages was beyond the scope of this research project.

In past decades, in Switzerland as in the rest of Europe, several educational programmes had been carried out to increase the knowledge of the general population about the harms of UVR exposure and the benefits of photo protection [7, 48, 49]. Nevertheless, it had been recognised that behaviours are difficult to change. There are a number of reasons for the unsatisfactory results obtained by photo protection campaigns: (1) tanned people are perceived as more attractive [50]; (2) knowledge of the risks of UVR conveyed is often superficial; and (3) the impact of UVR protection behaviour is not easily and rapidly perceived, since there is a time lag between sun protection behaviour and its long-term benefits. Furthermore, there are also critical opinions about the benefits of UVR protection preventive recommendations; for example, the independent US Preventive Services Task Force (USPSTF) stated that the current evidence is insufficient to assess the balance of benefits and harms of counselling adults older than age 24 years about minimising risks to prevent skin cancer [51]. There is even growing evidence for some beneficial effects of UVR, such as (1) reinforcing effects on mood [52], (2) a beneficial effect on blood pressure [53], and (3) a positive effect on vitamin D levels [54]. It is hence comprehensible that the general population's motivation for UVR protection is limited.

Additionally, the cause and effect between UV exposure and the incidence of NMSC has been shown multiple times [3], whereas for melanoma this correlation seems to be less clear [55].

Our findings indicate that further work is needed in the education of the general public, and athletes in particular. A structured programme aimed at improving skin cancer awareness, as well as proper sun exposure behaviours, in young pupils may be part of the final suggestion. Of course this should be validated in a formal study.

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Appendix

Questionnaire translated from the original German

Figures (large format)

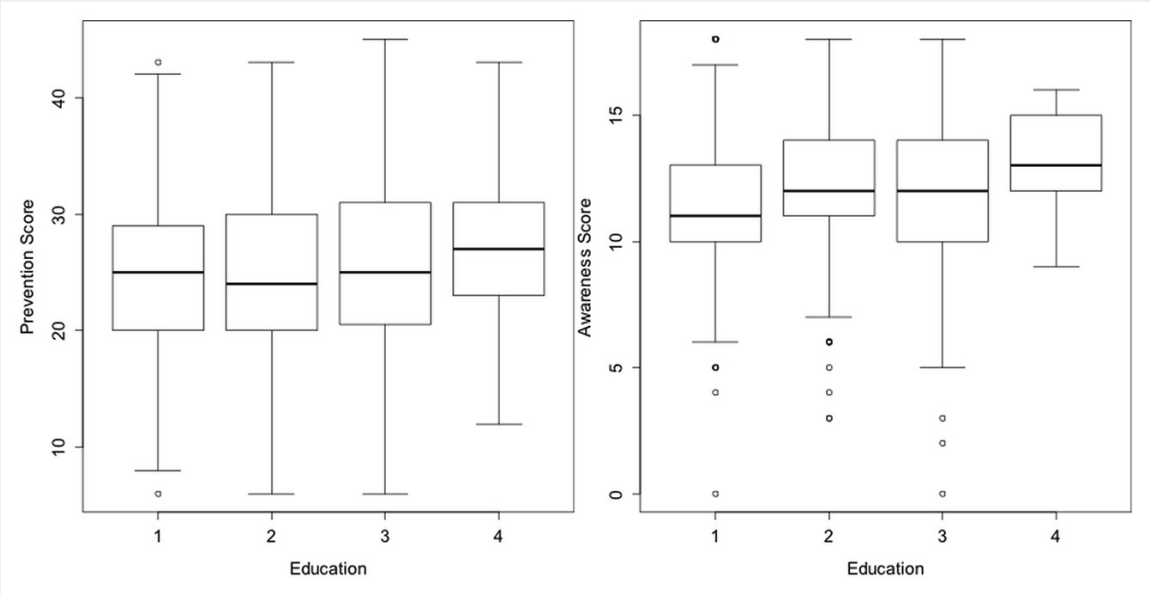

Figure 1

Box plots of the ultraviolet radiation prevention and the skin cancer awareness scores and the educational attainment of the participants, univariate level.

The correlation between the UVR prevention score and educational attainment was not significant (p = 0.24). Educational attainment was significantly associated with the awareness score at univariate level only (p = 0.01). 1 is the highest and 4 the lowest educational level. The educational attainment of the participants was grouped into four different subcategories according to the Swiss educational system: (1) university degree, (2) school of applied science, (3) apprenticeship, and (4) basic education.

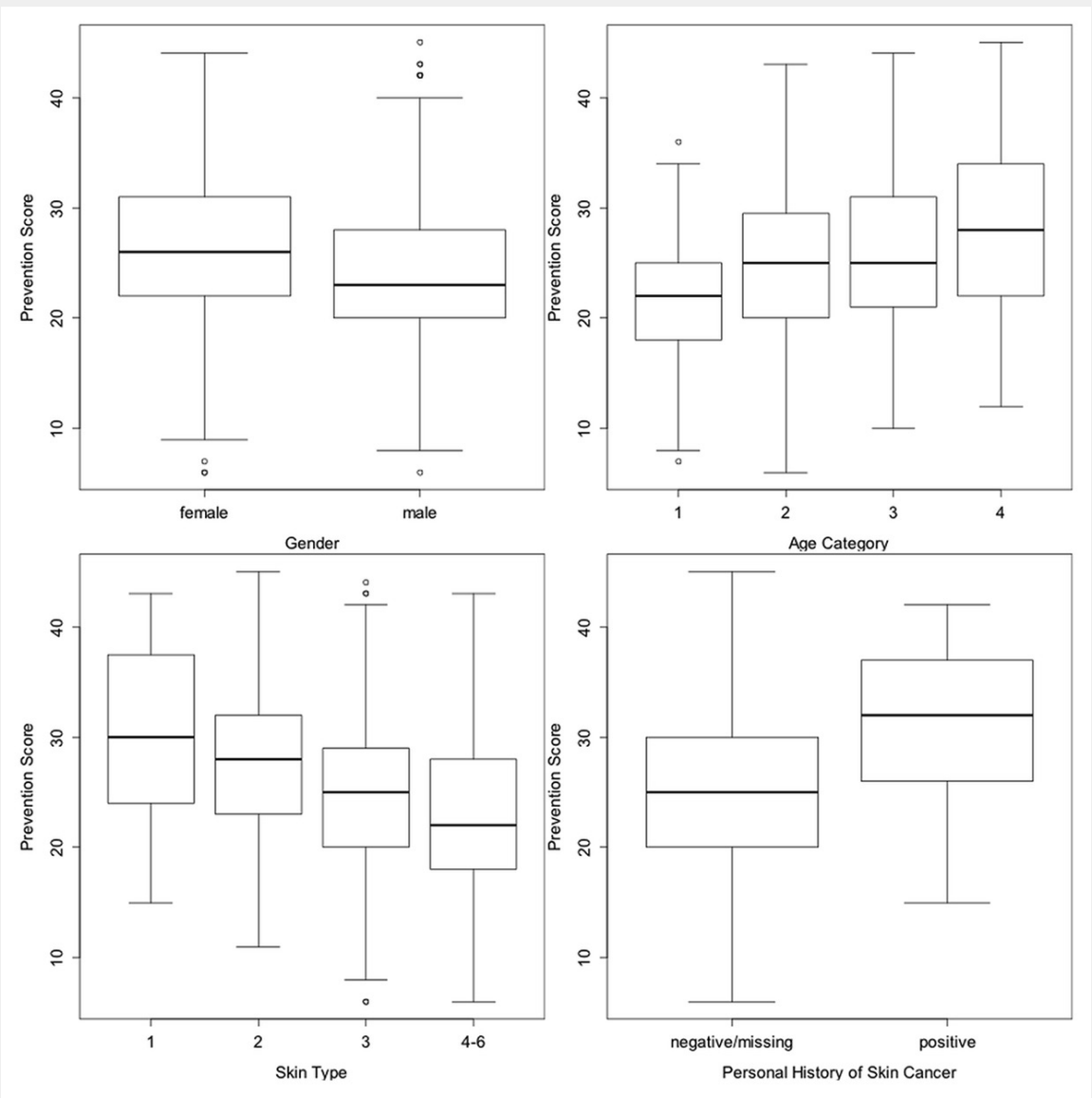

Figure 2

Box plots of the ultraviolet radiation prevention score and gender, age category, skin type and personal history of skin cancer of the participants, univariate level.

The correlation between the UVR prevention score and gender, age category, skin type, and personal history of skin cancer were statistically significant (for individual p-values refer to table 2).

Four age categories were made, based on the year of birth of the athletes: Category 1 (18–24 years), category 2 (25–34 years), category 3 (35–54 years) and category 4 (≥55 years). The skin type was divided into four different groups: category 1 (Fitzpatrick skin type I), category 2 (Fitzpatrick skin type II), category 3 (Fitzpatrick skin type III) and category 4 (Fitzpatrick skin type IV–VI).

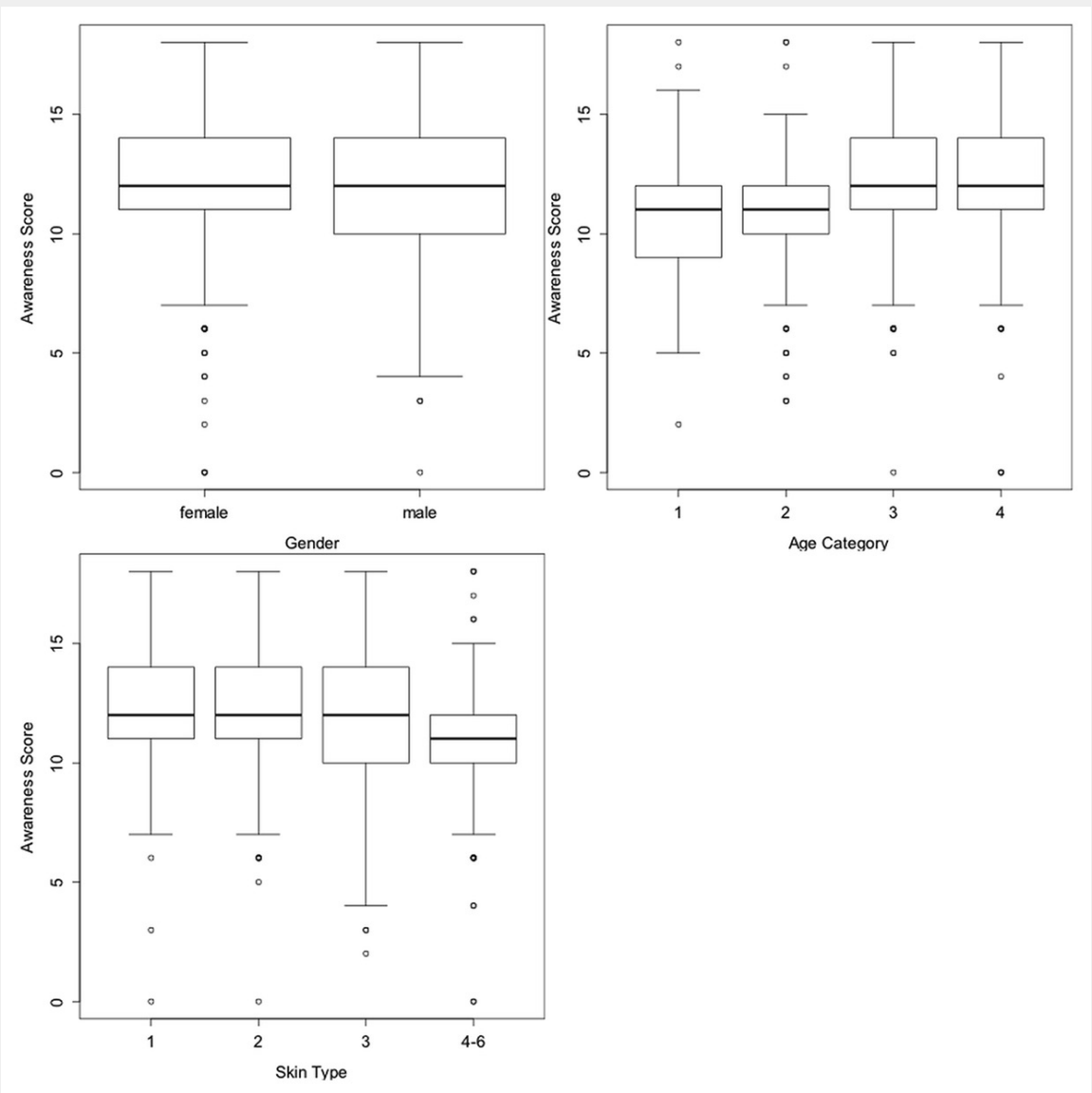

Figure 3

Box plots of the skin cancer awareness score and the gender, the age category and the skin type of the participants, univariate level.
The correlation between the skin cancer awareness score and gender, age category, and skin type were statistically significant (for individual p-values refer to table 2).
Four age categories were made, based on the year of birth of the athletes: category 1 (18–24 years), category 2 (25–34 years), category 3 (35–54 years) and category 4 (≥55 years). The skin type was divided into four different groups: Category 1 (Fitzpatrick skin type I), category 2 (Fitzpatrick skin type II), category 3 (Fitzpatrick skin type III) and category 4 (Fitzpatrick skin type IV–VI).