

Addressing the Need for UV Protection in Preparticipation Physical Evaluations: An Exploratory Study

Integration einer UV-Schutz-Beratung in die sportmedizinische Untersuchung: Eine explorative Studie

Summary

- **Objective:** Athletes who regularly train outdoors are more likely to be exposed to ultraviolet (UV) radiation, a major risk factor for skin cancer. However, the importance of adequate UV protection in sports is still an underdiscussed topic among athletes and officials. We developed a strategy for UV protection consultation (UVPC) for compulsory preparticipation physical evaluations (PPEs) and conducted this study to explore athletes' UV exposure and protective behaviors, as well as feasibility and acceptance of UVPC.
- **Methods:** In a cross-sectional study, we administered a survey to athletes who underwent a PPE at one of 23 participating certified sports medicine centers in Germany (22 in Saxony, 1 in Schleswig-Holstein) from February to June 2025. The questionnaire assessed individual UV exposure and protective behaviors. Based on the results, sports physicians provided a structured UVPC. Physicians provided online feedback on feasibility and acceptance of the procedure. The outcomes are described descriptively. Regression analyses were conducted to identify factors associated with protective behaviors.
- **Results:** Athletes' (N=375; mean age=16 years; male=50%) UV exposure varied greatly by sport. Increasing outdoor training time and prior sunburn were significantly associated with protective behaviors. Half of the athletes received a UVPC. The procedure was feasible and well-accepted by the majority of physicians (N=9).
- **Conclusions:** Overall, a UVPC is feasible and well-accepted in its suggested form within PPE. Athletes' individual UV exposure should be considered for a more targeted approach.

KEY WORDS:

UV Exposure, Outdoor Sports, UV Protection Consultation, Preparticipation Physical Evaluation

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Introduction

Athletes who regularly train outdoors have a high exposure to UV radiation, which is a risk factor for the development of skin cancer (7, 19, 22). Several studies show UV exposures in outdoor athletes that significantly exceed maximum exposure limits (17, 18, 21). In an Austrian study of 210 marathon runners, runners had significantly more atypical melanocytic nevi and lentiginos solares than age- and gender-matched controls and were more frequently referred to dermatologists for removal of skin lesions (1). Reported prevalences of sunburns among athletes range from 17% in a population-based German sample (9) to 85% in elite kitesurfers from Spain (4), illustrating the need for an individual, context-dependent risk assessment. UV protection measures, e.g. wearing long-sleeved clothing, headgear, sunglasses, avoiding midday sun (11:00-15:00), seeking out shade and using sunscreen SPF ≥ 30 are recommended at a UV index of 3 or above, which is reached or exceeded in Germany from April to September (2). Corresponding recommendations for outdoor sport contexts have been described elsewhere (6). However, studies suggest that despite

sufficient knowledge about the risk of skin cancer, protective measures are often inadequately implemented (5, 8, 11, 16) and systematic approaches to raise UV protection awareness amongst athletes, coaches, and officials are still needed.

The National Center for Tumor Diseases Dresden (NCT/UCC) and the University Cancer Center Schleswig-Holstein (UCCSH) are developing strategies for UV protection awareness in sports within the "Clever in sun and shade" (CISUS) campaign by German Cancer Aid and further partners (20).

Within this project, an exploratory study on feasibility and acceptance of a brief UV protection consultation (UVPC) as part of the annual preparticipation physical evaluation (PPE) for squad athletes was conducted.

Materials and Methods

In a cross-sectional study, we administered a full survey to all athletes who underwent a PPE at one of 23 participating certified sports medicine centers (SMCs). >



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Table 1

Athletes' characteristics.

	POPULATION VALUE
N	375
Years, M (SD)	16.4 (5.2)
Gender (%)	
male	189 (50.4)
female	163 (43.5)
missing	23 (6.1)
Squad/cadre membership (%)	
yes	366 (97.6)
no	8 (2.1)

Table 2

Weekly training time (hours) and UV score. UV score: sum score of items 9.1-9.8 of the UV questionnaire (UVQ) with a minimum of 0 and a maximum of 24; higher scores indicate better UV protection behavior; ¹: n=374; ²: n=364; ³: n=375.

	MIN	MD (QUARTILES)	MAX
Training time, total ¹	2.5	12 (8;16)	50
Training time, outdoors ²	0	6 (1;12)	40
UV score ³	0	10 (7;12)	19

Subjects

Athletes undergoing PPE at one of 22 SMCs certified by the Landessportbund Sachsen (LSB, state sports federation in Saxony), Germany, or at the sports medicine center of the Christian-Albrechts-University (CAU) in Kiel, Germany, from February to June 2025, could participate in the study. Written informed consent from adult athletes and from parents for underage athletes was mandatory. Participation was voluntary for all athletes and physicians.

Data Collection

State squad athletes in Saxony received the study materials between February and June 2025 from LSB. Athletes were asked to bring the completed UV questionnaire (UVQ) and the signed declaration of consent to the PPE appointment or to complete it on site. At SMCs of the University Hospital in Dresden and the CAU in Kiel, study documents were also issued to athletes without squad membership. The subsequent UVPC took place during PPEs at the SMCs. The sports physicians provided their feedback on feasibility and acceptance via an online survey from August to September. There was no compensation for expenses. The study received ethical approval from the Ethics Committee of TU Dresden, BO ff (Multi)-EK-77022025.

UV Screening

The UVQ comprised questions about age, gender, sports discipline, and weekly training hours as well as specific UV-related questions: weekly outdoor training time during summer season, participation in a training camp in southern regions (defined as UV index of 3 or above in January/February) and occurrence/number of sunburns in 2024 or 2025. Eight questions

measured UV protection behavior: wearing headgear, sunglasses, shoulder-covering clothes, applying sunscreen with SPF ≥ 30 before practice and reapplying it during longer sessions, training in the morning or evening, training in the shade, and spending rest periods in the shade. Each item had to be rated for its frequency: „always“ (scored 3), „often“ (2), „sometimes“ (1), „never“ (0) or „does not apply/not possible“ (0). Athletes who in sum scored ≤ 8 and/or who reported ≥ 1 sunburn during the last season/year and/or who trained ≥ 5 hours outdoors during summer season were classified as having a high risk of excessive UV exposure (=UV exposure criterion), thus fulfilling criteria for UVPC. Sports physicians had to indicate if they had given UVPC (see supplemental material online). Completion of the UVQ took around 5 minutes.

Consultation

UVPC was mandatory for athletes classified as high risk via UVQ. UVPC was structured by a handout (see supplemental material online) and included a brief overview about risks of excessive UV exposure during practice. Advice on UV protection measures was also given (13). Sports physicians were asked to encourage athletes to implement these measures as often as possible. Physicians could give out information with key UV protection tips and a QR code linking to a sports UV protection video.

Feasibility and Acceptance

Sports physicians completed an online survey comprising questions about demographics, professional experience with PPEs and whether they had addressed UV protection before the study. Feasibility and acceptance of the UVQ were assessed by physicians indicating their approval of four statements on 4-point Likert scales. To assess feasibility and acceptance of the UVPC and future integration into PPE, they rated seven further statements on the same 4-point scale (see supplemental material online). They could also provide feedback on implementation problems, missing aspects, frequently asked questions, or comments from athletes. Survey completion took around 5-10 minutes.

Data Analysis

Descriptive statistics were calculated to characterise the study population (athletes and physicians). The highest number of weekly hours exercising outdoors during the summer season was used to measure athletes' sport-related UV exposure. Frequency distributions of UV protection items were analyzed, and a sum score (UV score) was calculated to evaluate individual UV protection behavior. For UVPC, frequencies of mandatory and optional cases based on the UV exposure criterion and corresponding (non-)realization rates were calculated. To examine potential factors influencing UV protection behavior, we performed a multiple linear regression analysis with UV score as the outcome and age, gender, weekly outdoor training time (hours), and sunburn prevalence (≥ 1 sunburn vs. none) as predictors. As residual plots indicated deviations from the homoscedasticity assumption, heteroskedasticity-robust standard errors were computed using the HC3 method to account for potential bias (15). Overall significance of the model was assessed using a Wald test. A logistic regression analysis was conducted to examine sunburn prevalence (≥ 1 sunburn vs. none) using age, gender, weekly outdoor training time (hours), and UV protection behavior (UV score) as independent variables. The final model included mean-centered age and its quadratic term to account for the non-linear relationship with the logit

of the outcome. Model significance was evaluated using the omnibus test and odds ratios with 95% confidence intervals were calculated. Feasibility and acceptance of UVPC and UVQ were evaluated by calculating the proportion of sports physicians who either tended to agree or fully agreed to the corresponding statements. All analyses were conducted using R (v 4.4.0).

Results

UVQ Data

In total, 375 questionnaires (n=145 from Kiel, n=230 from Saxony) were included in the analyses. Table 1 presents athletes' characteristics.

Altogether, 66 different entries of sports disciplines were provided, resulting in at least 45 different kinds of sports. The five most frequently practiced sports were sailing (including windsurfing, n=50), track and field (all disciplines, n=45), handball (n=29), canoeing (n=28), and volleyball (n=21) as well as shooting sport (n=21). 55% of athletes practiced at least 5 hours per week outdoors, and approximately one-third had experienced at least one sunburn during practice or competition in the last season. Tables 2 and 3 give an overview of athletes' training volumes, UV scores, and sunburn rates. Implementation frequencies of different UV protection measures were mixed (see figure 1).

Based on the defined UV exposure criterion, UVPC was mandatory for the majority of athletes. UVPC was conducted for over half of them, and percentages of advice not given or not desired were small. If the consultation was optional, it was also given to many athletes. In total, more than half of the athletes got UVPC. However, approximately one-third of the questionnaires lacked specification of (non-)realization. Possible reasons are discussed below. Table 4 provides an overview of UVPC realization.

The multiple linear regression model regarding UV protection behavior was significant (F(4,337)=18.59, p<.001): incidence of at least one sunburn (b=2.01, SE=0.48, t(337)=4.22, p<.001) and outdoor training time (b=0.16, SE=0.03, t(337)=5.06, p<.001) were significant predictors of the UV score, whereas age and gender were not. These findings suggest that individuals with increasing outdoor training time

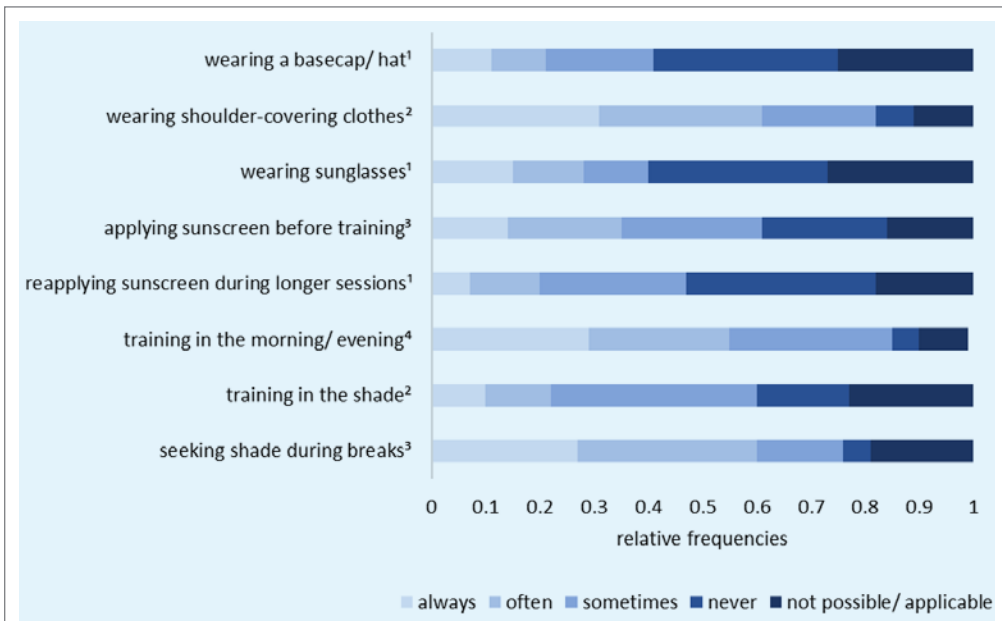


Figure 1 Frequencies of implementation of different UV protection measures reported by athletes. ¹: n = 372; ²: n=370; ³: n=371; ⁴: n=365.

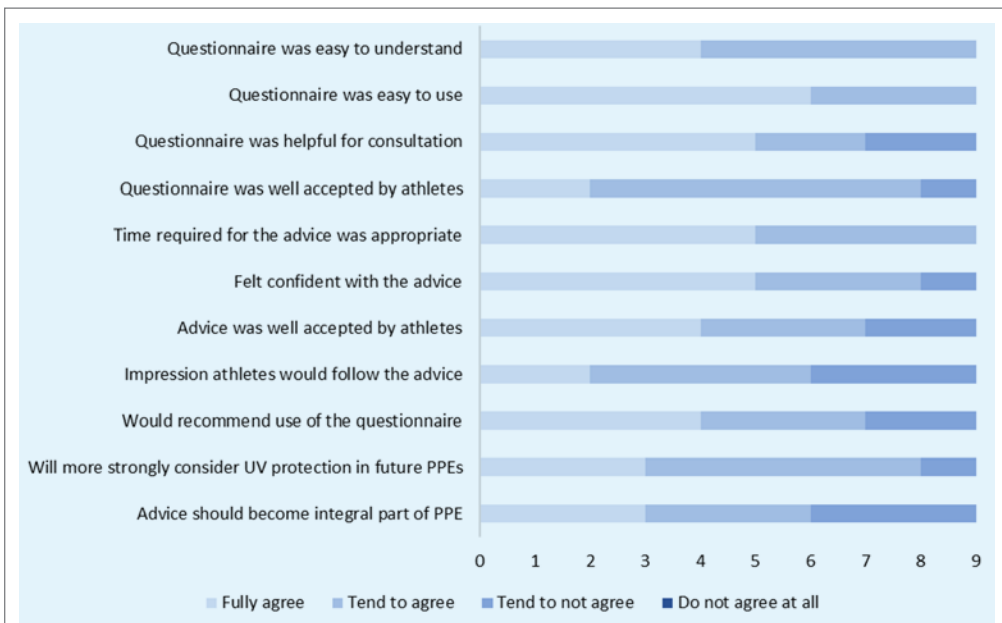


Figure 2 Sports physicians' (n=9) feasibility and acceptance ratings of UV questionnaire (UVQ), UV protection consultation (UVPC) and future integration into preparticipation physical evaluation (PPE).

and a history of sunburn during sport tend to take more UV protection measures. As the model explained approximately 17% of the variance in UV score (adjusted R²=.17), a large part of the variance remains unexplained and additional unmeasured variables may contribute to differences in UV protection practices.

In the logistic regression model, both UV score (OR=1.18, 95% CI [1.10, 1.29], p<.001) and outdoor training time (OR=1.08, 95% CI [1.04, 1.13], p<.001) were significantly associated with an increased odds of experiencing at least one sunburn. Age showed a nonlinear trend: the linear term was positive (OR=1.11, 95% CI [1.00, 1.24], p=.049), while the quadratic term suggested a decreasing risk with increasing age (OR=0.99, 95% CI [0.99, 1.00], p=.073), indicating an inverted U-shaped re- ➤

Table 3

Reported sunburns obtained during practice or competition in 2024 or 2025. 'other'=verbal quantification, e.g. „often“, „sometimes“, „regularly“, etc.

SUNBURN	N (%)
yes	112 (29.9)
no	262 (69.9)
Number of sunburns	
1-5	93 (24.8)
6-10	7 (1.9)
11-15	0 (0.0)
15-20	1 (0.3)
other	11 (2.9)

Table 4

Realization of mandatory and optional UV protection consultations. Consultation was mandatory if training hours outdoors ≥ 5 h and/or UV score ≤ 8 and/or ≥ 1 sunburn during training/competition in 2024 or 2025.

	ADVICE		TOTAL (%)
	MANDATORY (%)	OPTIONAL (%)	
N	307 (81.9)	68 (18.1)	375 (100)
realized	164 (53.4)	32 (47.1)	196 (52.3)
not realized	27 (8.8)	2 (2.9)	29 (7.7)
not desired	12 (3.9)	6 (8.8)	18 (4.8)
not specified	104 (33.9)	28 (41.2)	132 (35.2)

relationship. A likelihood-ratio test indicated that including the squared age term significantly improved model fit compared to the model without this term ($\chi^2(1)=4.00$, $p=0.045$) and the final model provided a significant improvement over the null model ($\chi^2(5)=74.06$, $p<0.001$) with a pseudo- R^2 (Nagelkerke) of .28. Gender had no significant effect ($p=.67$).

Online Survey

The online survey was accessed 17 times, and $n=9$ physicians completed it. Their mean age was 54 years ($SD=8.76$), 47% were female, and their average experience in conducting PPEs was 18 years ($SD=10.34$). In total, slightly more than 600 PPEs were conducted during the study phase and slightly more than 400 PPEs included UVPC. Two physicians had exclusively conducted PPEs with underage athletes, and five physicians reported to have already addressed the topic of UV protection in PPEs in previous years, although none of them had been asked about UV protection by athletes. One physician reported to have given UVPC to all athletes regardless of individual risk to generally encourage UV protection behavior. Median time for UVPC was around 3 minutes. Physicians' ratings of feasibility and acceptance of UVQ, UVPC and its future integration into PPE are shown in figure 2. Altogether, both questionnaire and consultation were feasible and well accepted by the majority of participants. However, one-third rather doubted that athletes would follow the advice. Athletes' questions regarding UV protection were mainly focused on sunscreen, like potential (dis-)advantages of certain ingredients or the unpleasant feeling on the skin. Most physicians were in favor of integrating UVPC into PPE in the future.

Discussion

This study demonstrates that implementation of UV protection measures is mixed, that UVPC can be integrated into PPE, and that UVPC is generally well accepted by sports physicians and athletes.

Regarding the implementation of UV protection measures among all athletes, training time (morning/evening), seeking shade during rest, and wearing shoulder-covering clothes are the most prominent. This is in line with findings from a nationwide survey among coaches from the 10 largest German outdoor sports associations, which revealed considerable untapped preventive potential especially regarding the reapplication of sunscreen, with the greatest deficits evident in football, tennis and swimming (12). Future studies should examine such sport-specific differences in the implementation of UV protection measures in greater depth.

For several protective measures, a relevant proportion of athletes indicated no application or difficulties in applying, possibly due to sport-specific structural barriers, such as competition rules, practice times and environments, clothing regulations and/or personal attitudes of athletes, but also coaches (e.g., lack of knowledge or not feeling responsible). These barriers can make implementation of UV protection measures considerably more difficult in sporting contexts (1, 12).

In the linear regression analysis, athletes with higher outdoor training time and a history of sunburn achieved higher UV scores. Therefore, exposure-related factors and prior experiences are related to protective actions. Neither age nor gender significantly predicted UV score, while other findings suggest that females and older individuals are more likely to engage in protective behaviors (3, 14). Our sample comprised a rather young and homogenous group, which could account for the non-significant associations in our model. The model accounted for about 17% of the variance in UV score, indicating that additional factors may contribute to differences in UV protection practices. Behavioral outcomes were examined exploratory and are typically influenced by a range of individual, environmental, and contextual determinants. Several potentially relevant variables – including sports discipline, situational conditions during outdoor training, skin type, knowledge and attitudes regarding UV risks and protection – were not included and may explain additional variability. Future research should therefore incorporate psychosocial determinants and environmental conditions to obtain a more comprehensive understanding of UV protection practices among athletes. The logistic regression analysis highlighted that both higher UV scores and outdoor training time were significant predictors of sunburn incidence. Factors like skin type or personal or family history of skin cancer were not assessed, but can also play a role in people's behavior (3). The implementation of health behavior is complex. Having a history of sunburn is influenced by UV protection behavior, and presumably increases the awareness of the need for UV protection. This underscores the importance of raising awareness through consultations, particularly when outdoor training time increases.

Certain aspects of the UVQ – particularly the scoring approach of the UV score – should be considered when interpreting the results. The UVQ was developed as a preliminary tool in the absence of an appropriate, scientifically validated tool, and was primarily intended to facilitate systematic identification of athletes requiring UVPC. A higher score in one item (e.g., training in the morning/evening) might coincide with lower scores in others (e.g., sunscreen use), resulting in a lower overall score without

necessarily reflecting reduced protection. Furthermore, a rather strict criterion was applied to define for mandatory UVPC. A simpler criterion – such as a sports discipline that is primarily practiced outdoors – might also have been sufficient for risk assessment. Nonetheless, this version of the UVQ provides an initial indication of athletes' UV exposure and protective behaviors.

The majority of physicians appraised the UVQ as easy to understand, practical to use, and helpful for subsequent consultations. At the same time, physicians' feedback suggested that it might be more efficient to focus on outdoor athletes and to ask certain key questions (e.g., hours exercising outdoors, sunburns, UV protection measures) on an individual basis rather than having all athletes answer the complete UVQ. Overall feasibility of UVPC was assessed as well. However, it was not specified whether UVPC was provided in around one-third of all cases. This suggests implementation challenges of the study procedure into routine medical assessments, possibly because of time constraints or logistic challenges (e.g. athletes forgetting to bring the UVQ, missing consent forms or physicians forgetting to tick the box on the UVQ). However, these challenges would be less relevant if the UVPC were routinely conducted in future PPEs. Physicians' feedback showed that some athletes had not filled in the UVQ because they had seen no need for it, especially indoor athletes. This could explain why some physicians did not have the impression that all athletes would actually follow the advice and that UVPC should not become an integral part of future PPEs. However, reported non-realization and rejection rates of the advice were low.

A strength of our study is the large sample size, comprising 375 athletes from a variety of sport disciplines and 9 physicians from different SMCs. This allowed a realistic assessment of feasibility and acceptance in real world practice, although not all participating physicians have provided feedback. The feedback received was predominantly positive and consistent. However, as our sample consisted predominantly of underage squad athletes, generalizability of the findings to older, less performance-oriented populations is limited. The study also relied on self-reported data, which can be subject to recall or social desirability bias. In addition, no follow-up assessment was conducted, as the main aim of this exploratory study was a first collection of data on athletes' UV exposure and protective behaviors as well as the assessment of feasibility and acceptance of UVPC by sports physicians. Subsequent studies should integrate a follow-up assessment to see if UVPC has an impact on athletes' behavior.

In conclusion, our results indicate that UVPC within PPE is feasible and well received and should be based on athletes' individual risk profile. The findings provide a basis for integrating systematic UVPC into PPE and suggest directions for future research and preventive strategies in sports settings. ■

Conflict of Interest

All authors have completed the ICMJE Uniform Disclosure Form at www.icmje.org/coi_disclosure.pdf and declare: No support from any organization for the submitted work, no financial relationships with organizations that may have an interest in the submitted work in the past three years, no other relationships or activities that may have influenced the submitted work.

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Ethical Approval

The study received ethical approval from the Ethics Committee of TU Dresden (Technical University Dresden), BO ff (Multi)-EK-77022025 (date of approval: August 29th 2025). Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Summary Box

What is already known about this topic?

- UV protection in outdoor athletes is crucial for preventing skin cancer. Systematic approaches to raise UV protection awareness amongst athletes, coaches, and officials are needed and a brief UV protection consultation as part of the annual preparticipation physical evaluation for squad athletes is suggested.

What does this study add?

- In this cross-sectional study, 375 German squad athletes' UV exposure and protective actions were assessed via questionnaire. Based on this risk profile, sports physicians provided UV protection consultations during preparticipation physical evaluations. Athletes' UV exposure, protective behaviors, and physicians' feedback on feasibility and acceptance of the procedure were evaluated by means of descriptive statistics and regression analyses.
- There is a significant association of increased outdoor training time and prior sunburn with protective behaviors. UV protection consultations were well accepted by physicians. The need for UV protection consultation should be based on athletes' individual risk profile.

References

- (1) **Ambros-Rudolph CM, Hofmann-Wellenhof R, Richtig E, et al.** Malignant melanoma in marathon runners. *Arch Dermatol.* 2006; 142: 1471-4. doi:10.1001/archderm.142.11.1471
- (2) **Bundesamt für Strahlenschutz (BfS).** Was ist der UV-Index? [Internet]. Salzgitter: Bundesamt für Strahlenschutz; [9 April 2025]. <https://www.bfs.de/DE/themen/opt/uv/uv-index/einfuehrung/einfuehrung.html>
- (3) **Christoph S, Cazzaniga S, Hunger RE, et al.** Ultraviolet radiation protection and skin cancer awareness in recreational athletes: A survey among participants in a running event. *Swiss Med Wkly.* 2016; 146: w14297. doi:10.4414/sm.w.2016.14297
- (4) **De Castro Maqueda G, Gutiérrez-Manzanedo JV, et al.** Sun exposure and photoprotection: Habits, knowledge and attitudes among elite kitesurfers. *J Cancer Educ.* 2022; 37: 517-523. doi:10.1007/s13187-020-01838-7
- (5) **Fernandez-Ruiz J, Montero-Vilchez T, Buendia-Eisman A, Arias-Santiago S.** Knowledge, behaviour and attitudes related to sun exposure in sportspeople: A systematic review. *Int J Environ Res Public Health.* 2022; 19: 10175. doi:10.3390/ijerph191610175
- (6) **Fieber V, Weigmann-Faßbender S, Stölzel F, et al.** UV protection during outdoor sports. *B&G Bewegungstherapie Gesundheitssport.* 2024; 40: 227-232. doi:10.1055/a-2366-3094
- (7) **Gandini S, Sera F, Cattaruzza MS, et al.** Meta-analysis of risk factors for cutaneous melanoma: II. Sun exposure. *Eur J Cancer.* 2005; 41: 45-60. doi:10.1016/j.ejca.2004.10.016
- (8) **Gilaberte Y, Trullàs C, Granger C, De Troya-Martín M.** Photoprotection in outdoor sports: A review of the literature and recommendations to reduce risk among athletes. *Dermatol Ther (Heidelb).* 2022; 12: 329-343. doi:10.1007/s13555-021-00671-0
- (9) **Görig T, Apfelbacher C, Drewitz KP, et al.** Sunburn and sun protection during recreational outdoor sport in summer: Findings from the German general population aged 16-65 years. *Photodermatol Photoimmunol Photomed.* 2023; 39: 589-597. doi:10.1111/phpp.12898
- (10) **Jinna S, Adams BB.** Ultraviolet radiation and the athlete: Risk, sun safety, and barriers to implementation of protective strategies. *Sports Med.* 2013; 43: 531-537. doi:10.1007/s40279-013-0021-5
- (11) **Kliniec K, Tota M, Zalesinska A, Łyko M, Jankowska-Konsur A.** Skin cancer risk, sun-protection knowledge and behavior in athletes - a narrative review. *Cancers (Basel).* 2023; 15: 3281. doi:10.3390/cancers15133281
- (12) **Leer S, Ehls C, Schneider S.** Guardians of the Game: UV-Specific Skin Cancer Prevention by Coaches in Outdoor Sports. *Photodermatol Photoimmunol Photomed.* 2025; 41: e70007. doi:10.1111/phpp.70007
- (13) **Leitlinienprogramm Onkologie (Deutsche Krebsgesellschaft, Deutsche Krebshilfe, AWMF).** S3-Leitlinie Prävention von Hautkrebs, Langversion 2.1, AWMF Registernummer: 032/052OL; 2021; [6 October 2025]. <https://www.leitlinienprogramm.onkologie.de/leitlinien/hautkrebs-praevention/>
- (14) **Lim HW, Saint Aroman M, Skayem C, et al.** Sun exposure and protection habits: Self-reported attitudes, knowledge and behaviours. *J Eur Acad Dermatol Venereol.* 2024; 38: 2024-2033. doi:10.1111/jdv.20080
- (15) **Long JS, Ervin LH.** Using heteroscedasticity consistent standard errors in the linear regression model. *Am Stat.* 2000; 54: 217-224. doi:10.1080/00031305.2000.10474549
- (16) **Mahé E, Beauchet A, De Paula Corrêa M, et al.** Outdoor sports and risk of ultraviolet radiation-related skin lesions in children: Evaluation of risks and prevention. *Br J Dermatol.* 2011; 165: 360-367. doi:10.1111/j.1365-2133.2011.10415.x
- (17) **Moehrl M.** Ultraviolet exposure in the Ironman triathlon. *Med Sci Sports Exerc.* 2001; 33: 1385-1386. doi:10.1097/00005768-200108000-00021
- (18) **Moehrl M, Heinrich L, Schmid A, Garbe C.** Extreme UV exposure of professional cyclists. *Dermatology.* 2000; 201: 44-45. doi:10.1159/000018428
- (19) **Narayanan DL, Saladi RN, Fox JL.** Ultraviolet radiation and skin cancer. *Int J Dermatol.* 2010; 49: 978-986. doi:10.1111/j.1365-4632.2010.04474.x
- (20) **Nationales Centrum für Tumorerkrankungen Dresden (NCT/UCC).** Clever in Sonne und Schatten – Gut geschützt vor UV-Strahlen [Internet]. Dresden: Universitätsklinikum Carl Gustav Carus Dresden; [12 May 2025]. <https://www.cleverinsonne.de/>
- (21) **Serrano MA, Cañada J, Moreno JC, Gurrea G.** Personal UV exposure for different outdoor sports. *Photochem Photobiol Sci.* 2014; 13: 671-679. doi:10.1039/c3pp50348h
- (22) **Snyder A, Valdebran M, Terrero D, Amber KT, Kelly KM.** Solar ultraviolet exposure in individuals who perform outdoor sport activities. *Sports Med Open.* 2020; 6: 42. doi:10.1186/s40798-020-00272-9