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Commentary: Sport-specific Factors Impacting Solar Ultraviolet Exposure in Individuals Who Perform Outdoor Sport Activities

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The epidemiologic and molecular links between ultraviolet radiation (UVR) exposure and subsequent development of both melanoma and nonmelanoma skin cancers have been well elucidated.[1] This relationship is explained by the tendency of UVR to form DNA-damaging reactive oxygen species, increase production of local growth factors, and impair cutaneous immune function in the skin.[2] Resulting DNA mutation and pyrimidine dimer formation occur.[3] The 2020 review article by Snyder et. al., demonstrated that outdoor sports participants are at a particularly high risk for developing skin cancers of all types.[4] Outdoor sports participants have high cumulative UV exposure and an elevated prevalence of pigmented lesions. This population also routinely exceeds recommended UV exposure limits. Additionally, unique sport-specific factors exist which further elevate this population's risk. Despite skin cancer rates rising annually, outdoor sports participants remain seemingly unaware of the risk of sun exposure and make inadequate or insufficient use of photoprotective measures [idem]. Implementing preventative strategies is key to mitigating athletes' elevated risk of developing cutaneous neoplasms.[2] In this commentary, we provide a review of sports-specific factors related to UV exposure, describe risk amongst different sports categories, and provide recommendations on protective strategies specific to those engaged in outdoor sports.

Sports-Specific Factors

The majority of accumulated UVR exposure occurs in the first 21 years of life, which is also the period of life in which most sports are practiced. On average, a young athlete may be exposed to as much as 1000 hours of sunshine per year.[5] This exposure time is often at peak hours of UVR, as many sports practices and competitions occur during the hours of 10 am and 4 pm. Other sport-specific factors to consider include altitude-related increases in UVR, reflection from water, snow- and ice-covered surfaces, and increased photosensitivity secondary to sweating.[3] In fact, sweat is known to significantly reduce the minimal erythema dose (MED), or the lowest amount of UV needed to produce defined skin erythema 24 hours after exposure.[2] Additionally, sweat, exposure to water, and friction may lead to decreased effectiveness of sunscreen.[3] A number of sports prohibit the use of protective gear such as sunglasses and hats.[6] Each type of sport practiced has intrinsically associated risks dependent upon location performed, participant interaction with elements, and the nature of the sport.

Aquatic Sports

Water not only reflects a significant portion of UVA and UVB rays, but also allows UV rays to penetrate and reach aquatic athletes beneath its surface. Additionally, aquatic sports are most likely to be performed during warm periods of the year when ambient levels of UVR are at their highest.[7] Despite claims of "water resistance," sunscreens wear off in the water and lose their protective ability. Manufacturers test SPF with only two 20-minute water immersions with moderate activity, which is not reflective of most aquatic athletes' duration or intensity of activity.[2] In a study of 240 elite aquatics athletes including surfers, windsurfers, and Olympic sailors, 76.7% reported at least one sunburn during the past year. Despite this, a significant number (22.5%) reported never using sunscreen, and were either unaware of, or ignored the fact, that reapplication is necessary.[5]

Alpine Sports

With every 1,000-foot increase in elevation, there is an estimated 8-10% increase in UV intensity. This is explained by a decreased opportunity for scattering of UVR at higher altitudes.[2] With increased elevation comes increased likelihood for snow and ice, which compound the effect of elevation by reflecting significant amounts of radiation [idem]. Rigel et al. measured the levels of UVR incurred by performance skiers and found that more than two thirds of the skiers studied received more than two MEDs of UV-B radiation per day.[8] However, a study assessing skiers and snowboarders knowledge of sunburn risk revealed that few had ever received messages regarding sun safety.[9]

Terrestrial Sports

Although outdoor recreational pursuits practiced on land lack the added risks associated with water and increased elevation, they represent a huge variety of sports which are engaged in by most sports participants. Golf is a very popular outdoor sport, with over 440 million rounds played in 2019. Particular attention should be paid to this sport because it often occurs during peak UV hours, lasts an average of 3-4 hours per round, and is played by a group who primarily self-report having fair or very fair skin. Despite these well-established risk factors, 39% of golfers reported that they did not believe participation increased their risk for skin cancer.[10] Marathon runners, soccer players, tennis players and field hockey athletes have all been shown to use sunscreen inadequately or not at all.[2] Additionally, Moehrle et al., describes a study which found that UV exposure in cyclists exceeded international exposure limits by greater than 30 times.[11] This pattern holds true for extreme sports participants as well, as ironman triathlon participants have reportedly experienced UVR amounting to 8.3 times their MED.[2]

Collegiate Athletics

College athletes represent another group of athletes exposed to hazardous amounts of UVR, yet most in this category do not participate in protective measures. In a study of 290 National Collegiate Athletic Association (NCAA) outdoor athletes, 43% reported never using sunscreen despite 96% agreeing or strongly agreeing that sunscreen will help protect them from the development of skin cancer.[12] Hamant et al. conducted a study that revealed even more dismal results, with 85% of participants, all of whom were collegiate athletes, reporting no sunscreen use in the previous seven days of practice.[13]

Childhood Athletics

Although early life exposure to UVR poses the highest risk of skin cancer,[5] few studies have focused on risk and exposure in children who take part in outdoor sports. Mahe et al. described a cluster-randomized study which revealed an increased number of UVR induced skin lesions in those children with outdoor sporting activity. The same study revealed that sun-protection measures in this group are inadequate both during and between their sports matches.[14]

Discussion

It is clear from the current literature that despite a well-established risk of skin cancer development for athletes practicing outdoor sports, knowledge about this risk and implementation of protective measures are lacking. Accordingly, this high-risk population necessitates intervention to educate and encourage adoption of photoprotection habits.

Primary prevention strategies are most effective in those groups who are large in number, at elevated risk, experience high prevalence of disease, and are accessible,[13] all of which describe most outdoor athletes. Strategies to reduce sun exposure include routine performance of self-skin examination and consultation with a medical specialist as needed. Reflecting the long latency period between environmental carcinogen exposure and cancer formation, skin cancer incidence increases markedly with age.[1] Therefore, surveillance should continue throughout life.

Other strategies include re-application of sunscreen and scheduling activities during periods when the UV index (UVI) is low, which typically occurs in early morning or late afternoon/evening [5,15] If an event runs longer than anticipated, holding the activity in the afternoon rather than the morning, when UVI is continually decreasing, is preferable.[15] Implementation of UVI meters in outdoor training and competition facilities would allow for real-time monitoring and, hopefully, prompt appropriate behavior modification. Additionally, posted signage with

the daily UV index forecast in places such as golf courses may serve as an important and much needed reminder to sports participants.[10]

Sports federations and associations should consider the actions they may take to promote or require appropriate use of sun protective measures by those participating in the competitions they organize. This may include the use of water-resistant sunscreen, seeking shady areas between matches, and wearing appropriate headgear, goggles, or sunglasses.[5] In Hamant et al.'s study of collegiate athletes, "sunscreen availability" was cited by 46% of respondents as the reason for not wearing sunscreen daily.[13] This highlights a need for increased availability of sunscreen dispensers at outdoor sports facilities for both players and patrons.[16] Provision of clothing with a UV protection factor of 40 to 50, which are increasingly available both as long sleeves and breathable fabrics, could also aid in sun protection for athletes.[17] Competition rules prohibiting application of sunscreen to certain skin sites, "official outfits" which do not provide adequate coverage, and banning of hats and sunglasses, all represent regulations warranting sports-association level intervention.[2] Finally, dermatologic societies may make use of the opportunity to implement and promote skin cancer screening campaigns during sporting events.[18]

Children engaged in outdoor sports are particularly optimal targets for such campaigns and other educational interventions, as it is easier to learn safe sun habits at an early age and develop a healthy attitude toward sun exposure.[13]

Conflict of Interest

The authors have no conflicts of interest to disclose.

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