Ultraviolet exposure in the Ironman triathlon

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ABSTRACT
MOEHRLE, M. Ultraviolet exposure in the Ironman triathlon. Med. Sci. Sports Exerc., Vol. 33, No. 8, 2001, pp. 1385–1386. Purpose: Skin cancer is increasing worldwide and exposure to ultraviolet (UV) radiation is thought to be the most important environmental risk factor. People practicing outdoor sports are exposed to considerable amounts of UV radiation from the sun. Methods: Three triathletes participated in the Ironman Triathlon World Championships 1999 in Hawaii (3.9-km swim, 180.2-km bike, 42.4-km run). They attached Bacillus subtilis spore film dosimeters (VioSpor) on the back between their shoulders. The dosimeter system measured cumulative biologically weighted erythemal UV exposure. UV exposure is given in minimal erythema doses (1 MED corresponds to 250 J·m⁻² at 298 nm). Results: The mean personal UV exposure was 8.3 MED (6.9 –9.7 MED) after 8:43 to 9:44 h of competition corresponding to 0.8 to 1.3 MED·h⁻¹ (bike and run). The athletes were sunburned despite the use of water-resistant sunscreen (SPF 25) on sun exposed skin. Conclusion: The International Radiation Protection Agency has issued guidelines for professional UV exposure. Ironman triathletes considerably exceeded these limits of exposure similar to other outdoor sports. Professional and amateur athletes should be aware of hazards caused by UV radiation. Adequate protection by water-resistant sunscreens and clothing as well as training and competition schedules with low sun exposure seem to be a reasonable recommendation. Key Words: DOSIMETRY, EXPOSURE

Ultraviolet (UV) radiation is estimated to be the most important environmental risk factor for the development of melanoma and nonmelanoma skin cancer (3,4). Practicing outdoor sports amateurs and professionals may considerably be exposed to UV radiation from the sun (5,8,9). Endurance athletes such as (Ironman distance) triathletes spend about 20 h·wk⁻¹ training outdoors. The aim of this study was to assess the UV exposure of athletes participating in the Ironman Triathlon World Championships 1999 in Hawaii using a new biological dosimeter system.

MATERIALS AND METHODS
Dosimeter. A new method of UV measurement has been developed using a film dosimeter containing dried spores of Bacillus subtilis. The spectral response of the spore film (VioSpor, Biosense, Bornheim, Germany) has been verified using spectroradiometers and is quite similar to the curve of erythema (2,7,12). The detector measures cumulative biologically weighted erythemal UV exposure. UV exposure is given in minimal erythema doses (1 MED = 250 J·m⁻² at 298 nm; 1 MED = the dose to generate erythema (sunburn) in nontanned skin (skin type 2).

Subjects. At the Ironman Triathlon World Championships 1999 in Hawaii (3.9-km swim, 180.2-km cycling, 42.4-km run), three male triathletes carried dosimeters attached to the back of their sports dress. During the swim UV exposure was limited, because the detectors were covered by a swimsuit. Written informed consent was obtained from all subjects.

RESULTS
The athletes needed between 8:43 and 9:44 h for the whole distance. During the competition personal UV exposures from 6.9 to 9.7 MED (mean 8.3 MED) were measured, corresponding to 0.8–1.3 MED·h⁻¹ during the cycling (180.2 km) and the marathon run (42.4 km). Despite the use of water-resistant sunscreen (SPF 25) on sun exposed skin, there was visible erythema (sunburn). It was more intense on the shoulders and thighs, as the Ironman rules prohibit the application of sunscreens on these sites.

DISCUSSION
UV exposure limits issued by the International Commission for Nonionizing Radiation Protection (ICNIRP) (6) and the American Conference of Governmental Industrial Hygienists (ACGIH) (1) were exceeded more than 30 times during this triathlon competition. UV exposure of triathletes can be compared with UV doses that have been measured in other outdoor sports, such as professional cycling or mountaineering (8,9). In most outdoor activities with exposed skin, even if performed for a short time in sunny conditions, the limit of exposure of 0.3 MED per 8-h workshift is likely to be exceeded.

The sunscreens partially might have been washed off by the sea water and sweating, thus being less effective. In addition, swimming in sea water (13) and sweating during cycling and running may additionally have increased individual UV sensitivity (11). Tanning always results from low-dose UV-related DNA damage of the skin, requiring
DNA repair. However, tanning may prevent acute damage (sunburn). The tan the athletes had from previous outdoor training and the use of water-resistant sunscreens was not sufficient to prevent sunburn during the competition. In addition, the rules and regulations of the Ironman competition prohibited sunscreen application on sites where race numbers were marked on the skin (14). Competitors should be advised to use sunscreen on these sites after race numbers had been marked. The application of sunscreen with a better water resistance and/or higher SPF is desirable.

Triathletes preparing for the Ironman competition spend about 20 h·wk⁻¹ training outdoors. As in other outdoor sports, protection of the skin by clothing should be extended but is limited by discipline specific conditions. Most sports clothing offers good clinical protection against UV radiation, depending on color and type of the fabric (10).

The study was limited by the small number of athletes and the lack of control (e.g., spectators, ambient radiation). UV exposure was measured at one single body site, on the back between the shoulders. Other sites, such as shoulders or head, were likely to receive higher UV doses. However, extended measurements, even with the small, lightweight dosimeters being used, would not have been tolerated by the athletes during the Ironman competition. It could be demonstrated that the dosimeter system is suitable for UV measurements in extreme outdoor sports. In conclusion, UV exposure of outdoor sport professionals as well as amateurs should be reduced by water-resistant sunscreens, adequate clothing, and by training and competition schedules with low sun exposure.

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