Letter to the Editor

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Ocular ultraviolet radiation exposure of welders

by Tenkate TD

This letter disputes the conclusion of Slagor et al that there are no studies of ocular ultraviolet radiation (UVR) exposure of welders. Using published results, a comparison with the UVR exposure of outdoor workers is provided.

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I read with interest a recent paper in your journal by Slagor et al on the risk of cataract in relation to metal arc welding (1). The authors highlight that even though welders are exposed to substantial levels of ultraviolet radiation (UVR), "no studies have reported data on how much UVR welders' eyes are exposed to during a working day." (1, p451).

Undertaking accurate exposure assessment of UVR from welding arcs is difficult, however, two studies have reported ocular/facial UVR levels underneath welding helmets (2, 3). In the first paper, UVR levels were measured using polysulphone film dosimeters applied to the cheeks of a patient who suffered from severe facial dermatitis (2). UVR levels of four times the American Conference of Governmental Industrial Hygienists (ACGIH) maximum permissible exposure (MPE) (4) were measured on the workers left cheek and nine times the MPE on the right cheek. The authors concluded that the workers dermatitis was likely to have been due to the UVR exposure received during welding.

In the other paper, a comprehensive exposure assessment of personal UVR exposure of workers in a welding environment was reported (3). The study was conducted at a metal fabrication workshop with participants being welders, boilermakers and non-welders (eg, supervisors, fitters, machinists). Polysulphone film dosimeters were again used to measure UVR exposure of the workers, with badges worn on the clothing of workers (in the chest area), on the exterior of welding helmets, attached to 11 locations on the inside of welding helmets, and on the bridge and side-shields of safety spectacles. Dosimeters were also attached to surfaces throughout the workshop to measure ambient UVR levels. For welding subjects, mean 8-hour UVR doses within the welding helmets ranged from around 9 mJ/cm^2 (3×MPE) on the inside of the helmets to around 15 mJ/cm^2 (5×MPE) on the headband (a location to approximate ocular exposure). UVR exposures for non-welding workers were also quite substantial, with mean 8-hour doses on the outside of safety spectacles being around 36 mJ/cm^2 (12×MPE) on the bridge and around 27 mJ/cm^2 (9×MPE) on the sides. Exposures measured on the outside of clothing was substantial (eg, mean 8-hour UVR dose for welders was around 9795 mJ/cm^2 (3265 ×MPE), with mean ambient UVR levels of 16.4 mJ/cm^2 (5.5×MPE).

The high ambient and "body" exposures measured in the study by Tenkate & Collins (3) are not unexpected, however, the levels measured within the welding helmets are of concern considering this represents UVR that has penetrated or by-passed standard protection measures. It has been shown that UVR is able to infiltrate welding helmets by entering from the back and through the sides and top (5). This type of infiltration is likely to occur when welders are in close proximity to each other and the welder is receiving exposure from other welder's emissions. In addition, facial/ocular exposure is also likely to occur when welders flip-up their welding helmet and undertake other work (eg, set-up, handle materials etc). For many welders, the proportion of their welding time per day compared to these other activities has been measured at around 20% (6), which means that if welders flip-up their helmet and leave it flipped-up, their eyes and faces are directly exposed to ambient UVR and that of nearby welders for a large part of the work day. Wearing safety spectacles underneath welding helmets is a recommended practice (7), however, workers report wearing safety spectacles, particularly underneath welding helmets, is uncomfortable, with visibility impacted due to fogging and sweat (8, 9). The use of auto-darkening helmets is one solution to eliminating the practice of flipping-up the helmet.

The Slagor et al paper (1, p451) also states that "we do not know whether welders are more or less exposed to UVR than outdoor workers", with reference made to the average solar UVR exposure of a Danish outdoor worker being 22 400 J/m^2 per year (min-max 5400 – 66 900 J/m^2 per year) (10). For comparison, taking the mean 8-hour UVR dose within the welding helmets as 15 mJ/cm^2 (3), this would equate to an annual ocular/facial UVR dose for welders of 37 500 J/m^2 (at 5 days/week, 50 weeks/year). Even though this value is weighted for the ACGIH action spectrum, and the value for the Danish outdoor workers is weighted for the erythema spectrum, it provides a reasonable comparison and indicates that welders are likely to receive comparable facial/ocular UVR doses to outdoor workers.

Slagor et al also state that "it is inferred that welders are not exposed to large amounts of UVR during their work life, in spite of the photokeratoconjunctivitis incidents" (1, p451). I would propose that the UVR dosimetry studies described above (2, 3), taken together with studies on UVR emissions of welding arcs which show that the MPE for many welding arcs can be exceeded in a matter of seconds (11–13), indicate that welders do

work in an extreme UVR environment. These studies also suggest that welders are regularly exposed to levels of UVR that exceed the occupational exposure limits at body sites which are thought to be protected (eg, face and eyes) (2, 3). When these exposures are further considered in light of the range of eye conditions reported to occur in welders (14–17), the importance of implementing a comprehensive eye safety strategy for welders and all workers in a welding environment is imperative.

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