

SOLAR UVR EXPOSURE OF OUTDOOR WORKERS (TINSMITHS) IN AUSTRIA

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ABSTRACT

To quantify solar ultraviolet radiation (UVR) exposure of a certain occupational group involved in typical outdoor work, a study was conducted using UVR-sensitive polysulphone (PS) film badges and electronic UV dosimeters.

More than 240 man day exposures, involving 14 workers, were accumulated between June and July 2005 at 7 different construction sites in the area of Klagenfurt and Villach (Carinthia, Austria, latitude: 46°N, altitude: ~500 m). A conversion factor giving the ratio between the measured erythral radiant exposure at different parts of the body and the global erythral radiant exposure was calculated to estimate the erythral radiant exposure for the workers for following years.

The study found that the investigated tinsmiths were exposed to high levels of UVR, in most cases without adequate personal protection against solar UVR.

IMPRESSION OF WORKPLACE CONDITIONS

Workers are frequently exposed to direct solar UVR and work with reflective materials (e.g. copper and aluminium sheets).

DATA COLLECTION

The workers were asked to wear the PS film dosimeters the whole workday and fix them always at their external clothing. PS film dosimeters were replaced on average after 3 workdays. The dosimeters were fixed at the following body parts:



neck and back of the head



chest



belt (only workers wearing no T-Shirts)

GUIDELINES AND TRESHOLD LIMIT VALUES

To estimate the workers' risk for UVR induced lesions of the eye and the skin the measured biologically effective radiant exposures have to be compared to threshold limit values. In this study the thresholds given in the table above were used.

The minimum erythral dose (MED) as given in the table for different skin types should not be seen as strict thresholds but rather as orientating values.

action spectrum	affected tissue	base	time	threshold limits	
				H _{eff}	E _{eff}
s _v	eye (cornea), skin	ICNIRP, ACGIH	8 h	30 J m ⁻²	
UV-A	eye (lens)	ACGIH	< 1000 s	10000 J m ⁻²	
			> 1000 s		10 W m ⁻²
s _{ery,z}	skin	CIE	8 h	10000 J m ⁻²	
				skin type I: 200 J m ⁻² skin type II: 250 J m ⁻² skin type III: 350 J m ⁻² skin type IV: 450 J m ⁻²	

FACTOR ANATOMICAL TO HORIZONTAL (ATH) EXPOSURE

One aim of the study was to compare the erythral radiant exposures at certain body parts of the workers to the horizontally measured erythral radiant exposures. If there was a good correlation between the anatomical and horizontal exposure a factor ATH (anatomical to horizontal) could be derived according to the following equation:

$$ATH = \frac{\text{effective anatomical exposure [J m}^{-2}\text{]}}{\text{effective horizontal exposure [J m}^{-2}\text{]}}$$

With this factor the UV-exposure of a certain body part can be calculated by knowledge of the effective horizontal exposure (this data is daily provided by the UV-index network).

RESULTS

The following table shows the average of the measured effective radiant exposures per workday (PS film dosimeters) for different parts of the body.

	neck	breast	cap (back of head)
erythral UVR s _{ery(z)}	1690 J m ⁻²	480 J m ⁻²	1360 J m ⁻²
actinic UVR s _{a(z)}	434 J m ⁻²	123 J m ⁻²	350 J m ⁻²
UVA	473000 J m ⁻²	134000 J m ⁻²	381000 J m ⁻²

The measurement results show that the workers accumulate effective UVR doses which exceed the threshold limit values by far. At the neck of the workers erythral radiant exposures up to 2700 J m⁻² per workday were measured and consequently the MED for skin type I (200 J m⁻²) was exceeded by more than a factor of 10.

If the average UVA exposure and the average actinic UVR exposure of the breast are taken into account to estimate the UVR exposure of the eye the corresponding threshold limit values are exceeded by a factor of 4 for the actinic UVR and by a factor 13 for the ICNIRP UVA threshold limit value.

The factor ATH was calculated for the erythral radiant exposure of the neck and the breast. The following average ATHs and standard deviations were calculated:

body part	ATH	standard deviation [%]
neck	0.50	± 19
chest	0.12	± 5

CONCLUSIONS

- Results indicate that there might be an increased risk for the investigated occupational group for UVR induced lesions of the skin, especially for melano-compromised workers (skin types I and II) as their skin adaptation to frequent UVR exposures (tanning and thickening of the epidermis) is less pronounced compared to melano-competent workers (skin types III and IV).

- There might also exist an increased risk for UVR induced lesions of the eye. As the eye can't adapt to UVR all workers seem to have the same increased risk for UVR induced lesions of the eye.

In a following study personal protection against solar UVR (sunscreens, textiles, sunglasses and headwear) will be tested in practice in order to evaluate their effectiveness of protection and their acceptability among the workers.

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Please note: This poster was originally published under our company's former name Austrian Research Centers.