INTRODUCTION: In our previous study, several parameters of oxidative stress and inflammation in the exhaled breath condensate (EBC) were significantly affected in workers exposed to nanoTiO₂ in the working atmosphere. In this study, the effect due to skin exposure with sunscreens containing TiO₂ with protective factor 50 was tested using markers of oxidative stress and inflammation, as systemic absorption from the creams cannot be excluded.

METHODS: Six subjects, mean age 48.0±8.3 years, 3 males and 3 females, used commercial sunscreen containing TiO₂ nanoparticles for 3.5 days (7 applications for 80% of the body, with and without UV irradiation in the tanning bed 2 x 8 min (0.01-0.02 W/m²). Total average cream consumption was 131.3±9.9 g/testing period. The same regimen was maintained with the UV application only. Collection of blood, exhaled breath condensate and urine was performed.

Following parameters were analyzed in all samples collected: pH, malondialdehyde (MDA), 4-hydroxy-trans-nonenal (HNE), 4-hydroxy-trans-hexenal (HHE), C6-C13, 8-isoProstaglandin F2α (8-isoprostane), 8-hydroxy-2-deoxyguanosine (8-OHdG), 8-hydroxyguanosine (8-OHG), 5-hydroxymethyl uracil (5-OHMeU), o-tyrosine (o-Tyr), 3-chloro-tyrosine (3-Cl-Tyr), nitrotyrosine (NO-Tyr), and leukotrienes (LT) B4, C4, D4, E4. Markers were analyzed by LC-ESI-MS/MS and TiO₂ in the samples was detected by ICP-MS and transition electron microscopy (TEM).

RESULTS: Analysis of the sunscreen confirmed TiO₂ with particles size distribution in the range 60-100 nm, the proportion of rutile and anatase was 80:20. Use of solarium increased most markers on Day 1 (after exposure) in the blood and EBC, but not in the urine. On the other hand, application of TiO₂ sunscreen did not decrease blood markers significantly, as can be seen in Figure 3. Ti in all blood (after centrifuge use) and EBC samples was under the limit of detection (LOQ) 1.2 µg/l. Only urine samples 2 after sunscreen use had both TiO₂ (ICP-MS 9-41 µg/l) and TEM (size 7-14 nm) positive, which however may be explained by contamination from the skin.


CONCLUSIONS: TiO₂-containing sunscreens may protect the skin against skin burning due to UVB irradiation. Rather surprisingly, the sunscreens may not protect against deleterious effects of the UVA irradiation due to oxidative stress, such as DNA, lipids and proteins oxidative damage. The oxidative stress effect of solely TiO₂ application was not detected. Possible skin absorption should be further studied.

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