Safety of nanoparticles in sunscreens

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To the Editor: More than 1000 sunscreen products are marketed in Australia, and an increasing proportion (about one-third) incorporate engineered nanoparticles (ENPs). Defined as manufactured particles having one or more dimensions less than 100 nm (0.00001 cm), ENPs exploit the altered chemical reactivity and other changes that reduction to nanosize elicits. ENPs in sunscreen, such as titanium dioxide (TiO_2) and zinc oxides, constitute effective broad-spectrum ultraviolet radiation (UVR) blocking agents with enhanced cosmetic transparency. The Australian Therapeutic Goods Administration (TGA), in approving such products, has stated that "there is no evidence that sunscreens containing these materials pose any risk to the people using them".[1] Similarly, authors of a recent article (written in collaboration with representatives of a cosmetic company) interpret the evidence as confirming that ENPs do not penetrate below the stratum corneum, or only in small amounts, producing limited cellular toxicity.[2] Information on sunscreen packaging is not required to disclose the presence of ENPs.

Yet, when TiO_2 nanoparticles are incorporated into human cells in vitro, mobilisation of electrons by absorption of ultraviolet A (UVA) light produces reactive oxygen species and causes DNA damage (strand breakage and base modification). In fact, TiO_2 has been used in this way to kill cancer cells in vitro.[3] In sunscreens and cosmetic preparations, TiO_2 is often coated to reduce this photocatalytic activity because over 90% of ambient UVR is UVA. However, evidence has now emerged that TiO_2 in uncoated anatase form has been added to a marketed but as yet undivulged Australian sunscreen — in this form, TiO_2 is capable of producing damaging photocatalytic free-radical reactions on particular steel roofing materials.[4] Likewise, zinc oxide ENPs manufactured for use in sunscreens are potent biocides and subject to disposal restrictions in most countries.

Despite the TGA's stance, existing research does not comprehensively ensure the safety of all ENPs in sunscreens, particularly ENPs less than 40 nm in size applied long term to human skin that is immature, aged, diseased, damaged, hairy or covering flexural creases.[5] The non-government organisation Friends of the Earth has compiled a list of sunscreens available in Australia that are claimed by the manufacturers to be free of nanoparticles.[6] A New South Wales Government committee has recommended that, for regulatory purposes, ENPs be considered new chemical entities that require increased safety data.[7] Policymakers should increase funding for objective research in this area (such as that by Macquarie University and the flagship project in nanotechnology of the CSIRO [Commonwealth Science and Industry Research Organisation]). Until such safety data are available, the TGA should apply the "precautionary principle"[5] and, at a minimum, increase packaging information about nanoparticles in sunscreens.

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