

Frequently asked questions about nanoparticles in sunscreens



Courtesy of Friends of the Earth Australia

Australia has the highest rate of skin cancer in the world. Using sunscreen is one important action to reduce the risk of developing skin cancer. Friends of the Earth Australia is committed to sunscreen safety, and to helping you and your family make an informed, safe sunscreen choice.

Why is Friends of the Earth concerned about nanoparticles in sunscreens?

- Some nanoparticles produce free radicals that can damage DNA and skin cells, especially with exposure to UV light
- If nanoparticles are absorbed into living skin cells, they could make sun damage to our skin worse, in a worst case scenario increasing the risk of skin cancer
- We do not yet know whether or not nanoparticles in sunscreens penetrate intact, healthy skin, although it seems possible they will be taken up through damaged skin. Many chemicals used in sunscreens act as 'penetration enhancers', which could also make skin penetration by nanoparticles more likely
- Nanoparticles are not subject to safety testing before being allowed in sunscreen
- Nanoparticles in sunscreens are not subject to mandatory labelling. This is especially a problem for people with skin conditions such as eczema, who may be more vulnerable to skin penetration, who cannot choose to avoid using nano

What are nanoparticles?

'Nanoparticles' are tiny particles, typically measuring 100 nanometres (nm) or less in one or more dimensions, or larger particles that have an internal structure at this scale (eg when they are composed of 'clumps' of particles <100nm in size)¹. To put 100nm in context: a strand of DNA is 2.5nm wide, a red blood cell is 7,000 nm and a human hair is 80,000 nm wide. 20-30nm particles are now used in many sunscreens– these nanoparticles are more than 200 times smaller than a red blood cell.

How are nanoparticles used in Australian sunscreens and cosmetics that contain sunscreens (secondary sunscreens)?

Tiny nanoparticles are used for their novel properties. For example, titanium dioxide and zinc oxide are commonly used in sunscreens and cosmetics to block UV light and give sun protection. As larger particles, these minerals are usually white and opaque (although some companies have found a way to make 1,000nm particles of zinc oxide transparent). When these particles are ground down to nano size, they become transparent. In 2006 Australia's sunscreen regulator the Therapeutic Goods Administration (TGA) said that 70% of titanium dioxide sunscreens and 30% of zinc sunscreens sold in Australia contain 'manufactured' nanoparticles (particles that have intentionally been produced in nano form)².

What are the health risks of using nanoparticles in sunscreens?

If nanoparticles are accidentally inhaled (eg from spray on sunscreen), eaten (eg when wearing sunscreen and handling sandwiches) or absorbed through our skin, they could pose health problems.

Scientific studies have shown that nanoparticles of titanium dioxide and zinc oxide commonly used in sunscreens can produce free radicals³, damage DNA⁴ and cause cell toxicity in test tube studies⁵, especially when exposed to UV light⁶. The concern is that rather than offering us sun protection, if they are absorbed into our skin, nanoparticles used in sunscreens could actually result in serious skin damage or other health harm. Last year, the director of CSIRO's Nanosafety research program told *The 7.30 Report* that: "the worst case scenario, I suspect, could be development of cancer. But we don't know. That's what we're trying to find out"⁷. Dr McCall cautioned that it will take up to another two years before the CSIRO can reach a conclusion on nano-sunscreens.

Animal studies have shown that after inhalation⁸ or injection⁹ into the blood stream of pregnant mice, titanium dioxide nanoparticles can cross the placenta and enter developing embryos. This has altered gene expression associated with brain function in the mice offspring¹⁰, affected their behaviour¹¹ and damaged the brains and reproductive systems of baby mice¹². Mice studies have also found that inhalation of nanoparticles of titanium dioxide caused inflammation to the lungs of test animals¹³. Furthermore, inhaled titanium dioxide nanoparticles can be transported to the brain¹⁴, raising concerns of potential neurotoxicity.

Will nanoparticles penetrate my skin?

Whether or not nanoparticles used in sunscreens will penetrate the dead outer layers of our skin, and pose risks to living cells, remains unknown. CSIRO and other researchers are conducting ongoing studies into skin penetration. The Australian Therapeutic Goods Administration, Australia's sunscreens regulator, claims that despite their potential toxicity, nanoparticles do not pose health risks because they remain in the outer layers of dead skin¹⁵. The problem is that not enough research has been done to know if this claim is true. Several studies have shown that nanoparticles used in sunscreens do not penetrate intact, healthy adult skin¹⁶. However Friends of the Earth is concerned that many factors that are relevant to real life conditions have not been included in these studies. We agree with a recent scientific review of the potential risks associated with nano-sunscreens that skin penetration research is required that takes into account real life variables including sunburn, skin damage and UV exposure¹⁷.

Scientific studies have shown that nanoparticles not used in sunscreen can penetrate skin¹⁸, especially if skin is flexed¹⁹ (as during exercise). Incredibly, one study found that even particles up to 1,000nm in size can be taken up through intact skin to reach living cells, when skin is flexed²⁰. The same study found that particles 1,000nm clustered in the living layers of the skin underneath a tear in the skin. But we are not aware of any studies that have looked at the influence of flexing on skin penetration of 20-30nm nanoparticles from sunscreens. Similarly, many chemicals found in sunscreens and cosmetics act as penetration enhancers²¹, increasing the absorption of other substances through skin. Although one study has found that penetration enhancers "greatly enhance" the uptake of

nanoparticles through skin²², to our knowledge the influence of penetration enhancers hasn't been explored in relation to nano-sunscreens.

Finally, nanoparticle uptake may be much greater in people with damaged or compromised skin, but skin condition hasn't been adequately investigated in relation to nano-sunscreens. Damaged skin can take up particles 70 times bigger than a nanoparticle²³, suggesting that skin penetration by nanoparticles is likely in people with eczema or acne. A recent study has shown that skin penetration by nanoparticles is also more likely in sunburnt skin²⁴. Nanoparticle penetration may also be greater through thinner skin – eg in elderly people or babies. A pilot study using elderly human volunteers that suggested that skin absorption of titanium dioxide nanoparticles took place²⁵ highlights the need for further research into skin condition and penetration by nanoparticles in sunscreens.

What are the concerns around chemical UV absorbers in sunscreens?

It is important to note that not all chemicals used in sunscreens as UV absorbers pose health risks, but there are growing numbers of people who prefer to use non-nano sunscreens that are free of chemical UV absorbers. Some UV-absorbing chemicals cause skin sensitivity²⁶. When exposed to UV light, other UV-absorbing chemicals produce free radicals that can interfere with cellular signalling, damage DNA, cause mutations and even lead to cell death²⁷. Some chemicals act as endocrine disruptors and can cause developmental toxicity²⁸. Finally, UV-absorbing chemicals including oxybenzone, octyl-methoxycinnamate (OMC), padimate-O, homosalate and octyl salicylate (octisalate) are not only rapidly absorbed by skin themselves, but also act as penetration enhancers, promoting the skin absorption of other chemicals²⁹. This can be a concern where such chemicals are used in products that also contain nanoparticles of zinc oxide or titanium dioxide.

What is the best sunscreen choice for me and my family?

You have a safe sunscreen choice! Given the concerns around the health risks of nanoparticles, and the potential problems associated with chemical UV-absorbers, Friends of the Earth Australia recommends using a non-nano, zinc based sunscreen. We have produced a safe sunscreen guide to help make this choice easy for you, available on our website at: <http://nano.foe.org.au>

What is the federal government doing to keep sunscreens safe and to give people an informed choice?

The Australian government is not doing enough to keep sunscreens safe, or to give Australians the ability to make informed sunscreen choices. The United Kingdom's Royal Society, the world's oldest scientific institution, recommended in 2004 that given the evidence of serious nanotoxicity risks, nanoparticles should be treated as new chemicals³⁰ and subject to new safety assessments before being allowed in consumer products³¹. It also recommended that nano-ingredients in products should be labelled, to give people the chance to make an informed choice.

This year the European Parliament passed new laws that will require most nanoparticles in

sunscreens and cosmetics to go through nano-specific safety testing before they can be sold, and to be listed on product labels. But the Australian Therapeutic Goods Administration (TGA) does not treat nanoparticles as new chemicals, require sunscreen or cosmetics manufacturers to conduct new safety testing of nano-ingredients nor require nano-ingredients to be labelled.

The TGA has also refused to release publicly the names of sunscreens that contain manufactured nanoparticles, despite previous requests from journalists³² and a Freedom of Information request from NSW Greens MLC Lee Rhiannon³³. The TGA's approach has been questioned by legal and medical academics at the Australian National University and Monash University who suggest that the potential for health harm warrants a precautionary approach to regulation of nanoparticles in sunscreens³⁴.

What can I do to help get better management of nano-sunscreen risks and mandatory labelling?

There are many things you can do to help get proper management of the new health risks of nano-sunscreens, and labelling that gives you and your family informed choice. Here are some ideas:

- Download a copy of our safe sunscreen guide at <http://nano.foe.org.au> to help you choose a sunscreen this summer
- Talk to your friends and family about the new risks of nano-sunscreens and how they can choose nano-free
- Distribute copies of our safe sunscreen guide in your workplace, sports team, childcare group or community centre – contact us for free copies
- Call the manufacturers of your favourites brands and ask them to go nano-free
- Email the Minister for Health Nicola Roxon and cc Parliamentary Secretary for Health Mark Butler, and let them know that you want precautionary management of nano-ingredients in sunscreens and mandatory labelling to give you a choice
nicola.roxon.mp@aph.gov.au
mark.butler.mp@aph.gov.au
- Support our work – contact Friends of the Earth to see how you can get involved with our campaign

Email: nano@foe.org.au
Phone: (03) 9024 3404
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