Nanoparticles in tattoo ink

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Researchers from the UK's University of Bradford have raised concerns about the dangers of some tattoo inks and their potential to cause illnesses, including cancers.[1]

Evidence has been found that nanoparticles from the ink can leave the skin (most likely via its dense network of blood and lymphatic vessels) and be transported to other organs of the body. Professor Tobin, Director of the University's Centre for Skin Sciences (CSS) believes that toxins in the dyes may accumulate in the spleen or the kidneys – the organs which filter impurities from the blood.

Given the enormous increase in tattooing in the last 10 years, Professor Tobin believes this is a potentially significant public health concern.

Millions of people around the world are tattooed. A 2006 American study found that up to 24% of people aged between 18 and 50 had tattoos.[2] However, still relatively little is known about the potential health consequences. This is despite a 2010 study by German scientists suggesting that millions of people in the Western world may have transient or persisting health problems after tattooing.[3]

To date, much of the debate around nanomaterials in consumer products has focussed on the use of nanomaterials in sunscreen. One of the significant toxicity concerns associated with nanomaterials is their ability to produce free radicals that can damage DNA and proteins. The extent to which nanomaterials in sunscreen can penetrate the skin is still hotly debated. However, unlike sunscreens, tattoos involve the injection of chemicals such as titanium dioxide (anatase and rutile forms), aluminium oxide and carbon black directly into the dermis. This has scientists worried.

A recent study, looking at a range of tattoo inks, found that the vast majority contained significant amounts of nanoparticles.[4] In particular, black pigments – those most used by tattooists - are usually made of carbon nanoparticles.

Carbon black is classified by the International Agency for Research on Cancer as possibly carcinogenic to human beings, based partly on inhalation studies on rats.[5] Studies have shown that carbon black nanoparticles can cause inflammation and damage DNA.[6] This damage is believed to be due to free radical production. Furthermore, studies confirm that nanoparticles of titanium dioxide and carbon black are more toxic and generate free radicals to a greater extent than larger particles of the same chemicals.[7]

Scientists are now suggesting that free radical production could be the cause of the high prevalence of symptoms such as swelling and itching reported by individuals with tattoos. In one study eighty-five per cent of complaints were related to black tattoos and fifty-eight per cent of these were induced by exposure to sunlight.[8]

Alarmingly, given their potential toxicity, it appears that tattoo inks are not as stable in the skin as one might think. A German study which investigated the fate of tattoo ink injected into the skin of mice, found that 32% of the pigment had disappeared 42 days after the injection.[9] Whilst larger particles are caught in the lymph nodes, studies with rats have shown that nanoparticles pass directly into the blood stream and can come to rest anywhere in the body.[10]

A 2009 Chinese study injected either silver nanoparticles or microparticles into the skin of rats. The researchers found that, whilst the microparticles could not reach the bloodstream, the nanoparticles did and then were distributed to the major organs - especially the kidney, liver, spleen, brain and lung.[11] The liver and spleen are believed to be the organs most likely to accumulate nanomaterials.

Nanoparticles are by no means the only potentially dangerous ingredients in tattoo inks. Solid science shows that many of the inks used in tattoos contain carcinogens.[12] This means people are having cancer-producing particles injected directly into their skin. Many tattoo ink pigments also decompose in the presence of sunlight to form toxic chemicals – some of which are known or suspected human carcinogens.[13] Surprisingly therefore a clear link between tattoos and skin cancer has yet to be identified.

Removal might not be the best option

Counter-intuitively, attempting to remove tattoos could actually increase any potential risks. Lasers are often used to remove tattoos which shatter the pigments, making the particles unstable and more likely to flow into the body's lymph system, and - if they are small enough - into the blood stream. Scientists are concerned that if these settle in an area, the harm could build slowly and only declare itself decades later, perhaps in the form of a cancer.

In Australia, our chemical regulator NICNAS (National Industrial Chemicals Notification and Assessment Scheme) claims it assesses industrial chemicals - including those in tattoo inks - that are new to Australia for their health and environmental effects prior to their use. However this is not the case for nano versions of existing chemicals.

In 2004, the UK Royal Society argued that nanomaterials have completely different properties to bulk forms of the same chemicals and should undergo proper safety assessments before they are allowed in consumer products.

NICNAS introduced regulation of nano forms of new chemicals in 2011, but has yet to introduce regulation for nano forms of existing chemicals such as titanium dioxide, aluminium oxide and carbon black. This means that these chemicals are being injected into peoples' bodies without even basic safety testing.

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