

Hair-raising uranium levels found

Novel study detects worrying levels of the heavy metal in residents in mining areas

SHEREE BEGA

A NOVEL new study using hair snipped from customers at barber shops across Gauteng has found how residents living in and near gold mining areas are exposed to elevated environmental levels of uranium, which eventually finds its way into their bodies.

The study, Human Exposure to Uranium in South African Gold Mining Areas Using Barber-Based Hair Sampling, aimed to uncover whether uranium enters the body and reaches elevated levels that can be detected in hair samples.

It was conducted by scientists from the International Agency for Research on Cancer (IARC), an arm of the World Health Organisation that probes the causes of cancer, together with researchers from Germany and South Africa.

Through a pioneering pilot study, the IARC is investigating whether uranium pollution might be linked to the development of cancers in gold mining areas on the Witwatersrand, which has 20 times more uranium dumps than the US and Canada combined.

"The main strengths of this study include the first direct human exposure measurement in the area concerned, the large sample, and the protocol that allowed sampling of also the most deprived communities," write the authors of the paper, published in the journal PLoS One last week.

Uranium (U) measurements in water, soil, and food related to gold mining activities in populated areas in Gauteng suggest the possibility of levels that might lead to adverse health consequences, including cancer, they write.

They note how the gold tailings of the Witwatersrand mining basin contain as much U as, or more U than, tailings from dedicated U mines, for example those in Germany or Namibia.

"It's been estimated that in Gauteng alone, approximately 1.6 million people live in close proximity to tailings dams, and growing informal settlements are moving closer and closer to them."

The pathways through which residents are exposed include the inhalation of windblown tailings dust and radon; consumption of polluted river water and groundwater; ingestion of food produced with contaminated water, including home-grown vegetables, meat and milk from domestic livestock; eating fish from polluted water; and intentional (geophagia) and unintentional (hand-to-mouth) consumption of contaminated soil, sediment and tailings material.

Professor Frank Winde, one of the study's authors and the head of the mine water research group at North West University, developed maps to identify the areas in which people are likely to be exposed to high levels of uranium.

In Gauteng, hair salons in wards with potentially high exposures were identified spanning the West Rand goldfield (Tudor Shaft, Kagiso Extension 6, Kagiso Extension 8, Rietvallei, Azaadville and Mindalore), in proximity to the upper Wonderfonteinsspruit, a heavily mining-polluted stream.

Salons in Khutsong North, on the Far West Rand goldfield further downstream of the Wonderfonteinsspruit stream were also selected, as well as in Diepkloof Zone 4 and Noordgesig, in the western part of the Central Rand goldfield were also selected.

Salons in Alexandra, Laudium and Randburg served as the control sites.

Overall, hair from 1 332 individuals was analysed.

"Composite hair samples representing the respective local populations were collected from regular (consenting) customers of selected barber shops over one to two months. A total of



MARIETTE Liefferink with hair samples gathered from hair salons in Khutsong, Diepkloof and Randburg. | NHLANHLA PHILLIPS African News Agency (ANA)

HOW THE CHEMICAL ELEMENT AFFECTS THE BODY

HEALTH effects reported for uranium (U) are attributed to the heavy metal chemotoxicity and, to a lesser extent, its radioactive properties, which are of growing concern if U is inhaled or ingested.

Recent findings from investigations of the health effects, including depleted U used in military conflicts, suggest a much wider range of toxicity, including

teratogenicity, disruption of the endocrine system by U mimicking estrogen's effects, and genetic damage as well as neurotoxic effects. Therefore, if high levels were confirmed in human populations investigations of subsequent adverse health effects, including cancer, would be justified. Human exposure to uranium in South African gold mining areas using barber-based hair sampling

70 U concentrations were determined in 27 composite samples from 1332 individuals."

Winde says: "The most important finding is that U-levels in hair are clearly elevated across the board compared to values for non-exposed populations elsewhere. In fact, a significant number of samples show U levels similar to those found in uranium miners in Slovenia."

"A difficulty we encountered was the fact, that U levels were also elevated in areas where we expected little or no impacts of U from gold mining activities to be present such as Randburg and Alexandra."

There are two likely reasons for this. "Barbers sampled in Alex and Randburg are located near taxi ranks and thus likely to also serve commuters living in mining areas and not only local residents. This increases U-levels at low

exposure-sites.

"Then, at the barbers located in high exposure areas we also may have had clients sampled from outside the mining areas."

He explains how one barber shop in Kagiso, for example, charged relatively high prices, attracting customers living well outside the mining area, with "some coming from as far as Mafikeng, according to the shop owner.

"A second problem, arising from the high price level, is the fact that this barber does not serve the indigent informal settlers we were actually targeting as the most exposed population group.

"Instead the barber served mainly black middle-class residents who are unlikely to use polluted stream water or consume contaminated home-grown food further reducing U-levels in the hair samples."

The concentrations measured merit research on possible adverse health consequences

STUDY AUTHORS

The combination of increasing U-levels at low exposure sites through co-sampling of commuters from nearby mining areas and the reduction of U-levels in high-exposure areas by sampling mainly middle class residents with comparatively little U-exposure as well as clients from outside the mining area eventually reduced and sometimes even reversed the differences between high and low exposure sites.

"Since we left the selection of suitable barber shops to a local NGO (the Federation for a Sustainable Environment) closely linked to the targeted communities, we only realised the suboptimal sampling site selection when probing the causes of the smaller than expected differences between high exposure and low exposure sites."

In the study, the authors note how although the high exposure wards col-

AUTHORS

THE study was authored by Frank Winde of North-West University, Gerhard Geipel of Helmholtz-Zentrum Dresden-Rossendorf and Carolina Espina and Joachim Schüz, both from the International Agency for Research on Cancer.

lectively showed higher U levels than low exposure wards, detected U levels were higher than those from most other surveys of the general public.

"U concentrations measured in the hair of the resident population of this South African gold mining area indicate elevated U levels that merit research on possible adverse health consequences.

However, collecting composite samples as a means of minimising analytical costs is discouraged, due to difficulties in their laboratory analyses, the authors write.

Winde says it's normal that by applying a new method of sampling – "and this barber-based approach is new" – strengths and weaknesses are discovered, which further improve the method for future applications.

"Since informal settlements are not open to applying conventional sampling techniques typically used in epidemiological studies such as drawing blood and collecting 24 hour urine samples (due to the lack of facilities including toilets for example), using hair from local barbers is a monitoring tool with great potential especially for poor countries where, commonly, the most severe exposure takes place.

"In contrast to blood and urine, hair also has the added advantage of reflecting pre-sampling U-exposure of the person for up to several months (depending on the length of the sampled hair, with each cm reflecting about one month of exposure) compared to hours or a day or two of blood and urine."

The results warrant a follow-up study simply based on the fact that detected levels are clearly elevated above natural background levels found in uncontaminated areas, he says.

"The study achieved its most important objective by proving that residents in and near the gold mining areas are indeed exposed to higher environmental levels of U which eventually finds its way into the human body via a number of exposure pathways. By having proven elevated U-uptake by residents the second step would now be to check what are possibly associated burdens of disease affecting the exposed population groups."

Mariette Liefferink, of the FSE, who collected the hair samples, says the study is a "novel and interesting approach to a non-invasive assessment of uranium load in humans".