

## **An epidemiological study of certain cancer types among Rössing Uranium Limited workers**

Raymond Agius<sup>1</sup>, Evridiki Batistatou<sup>1</sup>, Matthew Gittins<sup>1</sup>, Steve Jones<sup>2</sup>, Roseanne McNamee<sup>1</sup>, Hanhua Liu<sup>1</sup>, Amir Rashid<sup>1</sup>, Martie van Tongeren<sup>1</sup>, Richard Wakeford<sup>1</sup>

<sup>1</sup> The University of Manchester, Division of Population Health, Health Services Research & Primary Care, School of Health Sciences, Faculty of Biology, Medicine and Health, Oxford Road, Manchester M13 9PL, United Kingdom

<sup>2</sup> SJ Scientific Ltd, Summerhill, 2 West Drive, Cheddleton, Leek, Staffordshire, ST13 7DW, United Kingdom

The Rössing Uranium Limited mine in Namibia has operated since 1976. It is an open-cast mine where uranium-bearing rock is blasted, crushed and processed chemically to produce uranium concentrate for export. Workers at the Rössing mine are exposed to radiation directly from radioactive materials in the rock, but may also breathe in radioactive dust and radon gas which can escape from the rock. Workers may also have inhaled other, non-radioactive, substances, such as acid mist. The University of Manchester was appointed by Rio Tinto (until recently, the major shareholder in the Rössing mine) to conduct an independent study to investigate if working at the Rössing mine is linked with a higher risk of developing cancer.

Using records held at the Rössing mine, the University of Manchester research team identified 7901 people who had worked at least one year at the mine between 1976 and 2010. We identified those who had developed cancer using the Namibia National Cancer Registry, the South African National Cancer Registry and information from the records of the mine's occupational health service. These worker records were carefully linked to cancer registry records, maintaining strict confidentiality. The study focussed on lung cancer, cancers of other parts of the airways, leukaemia (cancer of the blood), kidney cancer and brain cancer. We

identified 32 cases of lung cancer, 18 other airways cancers, 8 cases of leukaemia, 9 cases of brain cancer and 9 cases of kidney cancer.

We obtained information on workplace exposures from the Rössing mine, in particular exposures to radiation but also exposure to silica, acid mist and diesel engine exhaust. This was done for workers who had developed a cancer of interest and for a representative sample of 1121 people from the whole workforce. This information was used to estimate overall exposures during the time these workers were employed at the mine. We also obtained information on other factors that may cause cancer, such as cigarette smoking and medical X-rays. Finally, we collected information on gender, date of birth, nationality, ethnicity and level of income, as these factors may also influence the risk of developing cancer. For example, we found that the number of lung cancers among black Namibian workers was much less than those for other ethnic groups. Based on additional analyses of all cancer cases in the representative sample of Rössing workers, we do not believe that this is just because fewer cancers occur in black Namibians. Instead, it is our opinion that it is less likely for cancer cases in black Namibians to be properly diagnosed and recorded by the cancer registries.

We carried out statistical analyses to identify if the risk of developing cancer was higher in workers with higher radiation exposures. These analyses showed that total radiation exposure in the Rössing mine was not associated with a higher risk of any of the cancers that we studied.

We conducted additional sensitivity analyses, and for one particular type of radiation (gamma radiation) we found in some of the analyses that higher radiation exposure was linked to a higher risk of developing lung cancers. Also, for inhalation of radioactive dust we found in some of the analyses suggestions of a possible link with lung cancer.

From large studies such as those of the survivors of the A-bomb attacks on Hiroshima and Nagasaki, it is well known that exposure to ionising radiation does

increase the risk of developing many types of cancer. However, radiation exposures for workers at the Rössing mine appear to be low, based on the data provided to us. At these radiation levels and from what is known about radiation risks we do not expect to see an increase in cancer incidence in the Rössing workforce. Moreover, for many workers the assessed radiation levels at work are similar to the exposure from naturally occurring background radiation in their everyday lives, such as exposure to radon in their homes.

Although we can never exclude the possibility that for some cancer patients the mine environment may have contributed to the development of their disease, this study does not provide strong evidence that radiation or other exposures at the Rössing mine cause an increased risk of cancers in the workforce.

CONFIDENTIAL