

Environmental inorganic arsenic exposure, human absorption and cancer incidence

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SUMMARY

The presence of inorganic arsenic concentrations in drinking water is a worldwide problem with significant public health implications. Inorganic arsenic is a known cause of skin cancer and is reported to have many other health impacts such as internal cancers, hyperkeratoses, vascular disease and neuropathy. The literature provides good epidemiological evidence that very high concentrations of inorganic arsenic in drinking water is associated with skin cancer and may be associated with internal cancers. There has been much discussion about the potential health effects from lower concentrations of arsenic in drinking water.

While inorganic arsenic is present in a wide range of concentrations in the environment, few studies have investigated the relationship between soil arsenic concentrations and health effects, probably because of the lower bioavailability of arsenic in soil.

Few studies have characterised the degree of absorption from different types of exposure. In most of the health studies conducted to date individual exposure has been poorly measured and the contribution of different sources of exposure has not been investigated.

Many areas in central and north eastern Victoria of Australia have been found to have high levels of arsenic in soil, groundwater and surface water, in some cases several orders of magnitude in excess of current national and international guidelines. The range of concentrations and locations provided an excellent setting to investigate human absorption from environmental arsenic exposure and to investigate any potential relationship between environmental arsenic concentrations and internal cancers.

A series of studies were conducted to:

- assess the degree of absorption of inorganic arsenic in residents exposed to varying arsenic concentrations in the environment;
- determine the contribution of different environmental sources to absorption;
- evaluate the risk factors for absorption and;

- investigate cancer incidence associated with high environmental arsenic concentrations.

The results of the studies showed that drinking water and residential soil arsenic concentrations were the most significant predictors of short and long term absorption. Season, age and drinking water consumption influenced short term measures of absorption, and age and sex were important for long term measures.

A reduction in urinary arsenic concentrations was observed in an intervention cross over trial using uncontaminated drinking water as the intervention. While the urinary arsenic concentrations of residents decreased after a washout period and while drinking uncontaminated water, the difference was not significant. The possible reasons for this result and implications are discussed.

An ecological study, conducted to investigate internal cancer incidence in 22 areas with high environmental arsenic concentrations did not support previous studies which suggested an association between drinking water arsenic and internal cancers. There was little evidence for suggesting an association between internal cancer and the presence of high concentrations of arsenic in soil.

This project has provided information on the degree of inorganic arsenic absorption following environmental exposure. The study has provided methodology to better assess individual absorption of arsenic among residents in potentially contaminated areas by using inorganic arsenic as the response variable. It has also provided data to better enable interpretation of arsenic concentrations in urine, hair and toenails in the future.