Government of **Western Australia**
Department of **Health**

Cadmium: advice for Christmas Island residents

What is cadmium and where is it found

Cadmium is a naturally occurring metal found in the earth's crust. It is always found combined with other substances such as oxygen (cadmium oxide), sulphur (cadmium sulphate, or sulphide) and chlorine (cadmium chloride). Cadmium compounds are often found in or attached to small particles in the air. Soil and rocks contain varying amounts – generally very small – but sometimes in larger amounts e.g. fossil fuels or fertilisers). Cadmium is extracted as a by-product during the production of other metals such as zinc, lead and copper. It has many uses in industry and consumer products, mainly in batteries, pigments, metal coatings, plastics and some metal alloys.

In Christmas Island cadmium is found in the phosphate rich deposits across the island. Phosphate rock naturally contains cadmium that can accumulate in the soil. Therefore, environmental dust may contain small amounts of cadmium. Activities, such as mining, that disturb the soil can increase the amount of dust in the air. Cadmium can also be found in water and vegetation. Cadmium from polluted soil and water can accumulate in plants and organisms, thus entering the food supply. Foods that can be high in cadmium include leafy vegetables, such as lettuce and spinach and root vegetables, peanuts, soybeans, and sunflower seeds, as well as shellfish and offal (liver and kidney). For smokers, cigarettes are a major source of cadmium.

Exposure

Exposure can occur by breathing or swallowing dust, eating contaminated food, drinking contaminated water, and smoking. Smoking almost doubles the amount of cadmium in the body compared to non-smokers.

Even in dusty environments ingestion is the main way most people and animals are exposed to cadmium. The exception is some occupations where exposure may occur through inhaling fumes and vapours rich in cadmium.

Compared to people, animals have different ways in which they may be exposed to substances such as cadmium, including their proximity to sources of contamination, diet and behavioural factors such as grooming dust from fur and exposed skin.

Health Effects

Health effects of exposure to cadmium depend on how you come into contact with it, the amount or level of cadmium present and the amount of time you are exposed. The most important known health effect from low, chronic (over many years) exposure is kidney damage. Exposure over a long period may also cause bones to become fragile and break easily.

Workers who have higher inhalation exposures have a potential for effects on the lung. Cadmium is classified as a Category 1 carcinogen (carcinogenic to humans) as lung cancer has been linked with cadmium exposure in animal studies and in some studies of workers exposed

to cadmium. Lung cancer is not typically associated with exposures to outdoor air (ambient air) in the general community.

The health effects from exposure to cadmium seen in children are thought to be similar to effects seen in adults. Effects on development as a result of exposure to cadmium have not been seen in humans. Studies in animals show that young animals are more susceptible to a loss of bone and decreased bone strength from exposure to cadmium than adult animals.

Environmental health data for Christmas Island

The Water Corporation has confirmed that levels of cadmium in drinking water sources on Christmas Island are below the Australian Drinking Water Guidelines.

Ambient environmental air quality monitoring is required to be undertaken by Phosphate Resources Ltd as part of their environmental licence condition L8846/2014/1 (https://www.der.wa.gov.au/component/k2/item/8390-l8846). However, these data are not readily available. Emission data from the kilns on the island shows that cadmium is being emitted but how much this contributes to the cadmium that may be present in the air from the natural environment is not known.

Soil data show that cadmium occurs naturally in soils on Christmas Island. As a result, the Health Department expects that there would be cadmium in air-borne dust from time to time if soil particles become air borne. Therefore, the Health Department recommends minimising exposure to dust and airborne particles where possible.

How to minimise exposure

Several measures can be taken to assist in reducing the potential for exposure to environmental sources of cadmium:

- Hand to mouth activity is more common in young children so regular hand-washing is recommended. Wash hands whenever you come inside from the garden or children have been playing outside, before you eat or drink, and after touching pets. Use soap and water and make sure hands are dry.
- Use good home hygiene: regularly clean dust off frequent contact surfaces by wiping with a damp cloth. Regular vacuuming with high efficiency particulate air (HEPA) vacuum cleaners will prevent dust being re-released back into your home.
- Wash children's toys thoroughly with soapy water if they have been outside for any length of time or dropped onto soil or dusty surfaces, especially toys and dummies (pacifiers) that are likely to be put in a child's mouth.
- Wash and brush family pets outside on a regular basis to minimise the amount of dust being brought indoors on their fur.
- Always wash all fruit and vegetables thoroughly before eating or cooking. Remove any peel from fruit grown on Christmas Island.
- Avoid entering and playing in mined areas or mine tailings.
- Do not smoke tobacco products (a recognised source of cadmium).
- A balanced diet and healthy eating habits can help minimise the absorption of cadmium into the body. Eat a healthy, balanced diet with adequate levels of calcium, iron, vitamin C, zinc and magnesium. Young children need frequent meals and snacks. Avoid high fat diets.
- As plants take up cadmium at different rates and under different soil conditions be aware that locally grown and home grown leafy green vegetable may contain high levels of cadmium. Wherever possible vegetables should be grown in clean soil / potting mix or limit the amount of any locally grown market produce eaten to 10 – 20 % of your diet.

Fruiting plants are less affected but should be washed to remove dust before consuming (or peeled).

Christmas Island Flying fox

Bat species have been suggested as potential “bioindicator species” for the presence of cadmium in the environment. However, exposure pathways of bats and humans are different, so detection of cadmium in bats does not necessarily indicate a risk of human exposure.

Phosphate mining (habitat loss and dust) has been identified as a threat to the Christmas Island Flying Fox population. Flying foxes can roam over the entire island, including into mining areas. For example, a Christmas Island Flying Fox camp was located near Daniel Roux cave beneath the phosphate dryer and all the vegetation in the camp was covered in phosphate dust for most of the year. Phosphate dust is likely to contain cadmium. Flying foxes may have been exposed to cadmium from eating dust covered pollen and fruit and from grooming/licking of dust covered fur.

Medical testing

Biological sampling for cadmium on Christmas Island has been available since 2017. Available environmental health data suggests elevated exposure to cadmium is not occurring on Christmas Island. However, testing remains available and only requires collection of a urine sample which can be done at the health service on Christmas Island with the test processed by PathWest in Perth, Western Australia.

Additional information for medical practitioners and environmental health practitioners

For any health surveillance/biological monitoring, information on potential exposure sources should be collected, including:

- Locations where people work/live
- Whether home grown produce is consumed and an estimate of how much it contributes to the diet (ie. 10%, quarter, greater than half).
- Consumption of Christmas Island grown fruits and approximate contribution to the diet.
- Whether regular diet is high in peanuts, soybeans, and sunflower seeds, shellfish or offal (liver and kidney)
- Age and sex
- Smoking history

Blood samples are more accurate for assessing recent exposure while urine samples are more accurate for assessing chronic exposure.

Urinary cadmium levels correlate with cadmium body burden and cadmium concentration in kidney. The relationship between renal and urinary cadmium appears to be nearly linear at chronic intakes and kidney burdens that do not produce nephrotoxicity (i.e., elimination half-time is independent of dose). The relationship is not linear for acute high exposure or where there is kidney damage.

The first indication of kidney damage is increased production of β2-microglobulin and increased urinary levels of intracellular enzymes such as N-acetyl-β-glucosaminidase (NAG); and increased excretion of calcium and metallothione.

Urine testing is the recommended test with additional β2-microglobulin (urine) at the discretion of the medical practitioner.

Hair analysis not recommended as it is not a reliable indicator of body burden or predicator or health effects.

Reference Guideline levels

Reference levels of β2-microglobulin urine

Heavy Metals Urine Reference Value

PathWest has advised persons with highly elevated urine cadmium levels (> 7 nmol/mmol Creat) and confirmed with a 24-hr urine collection are at high risk, exposure should be reduced immediately, and the person investigated further for renal disease or immune-deficiency diseases.

The following Environmental health exposure values are provided for awareness. The Chemical Hazards team in the Environmental Health Directorate of the Department of Health can assist with Information about their use, application and interpretation. The team can be reached on 9222 2000 or DOH.ChemicalHazards@health.wa.gov.au

Environmental health exposure:

Acute air guideline	0.00002 mg/m^3	DOH
Chronic air guideline	0.00001 mg/m^3	DOH

Drinking Water	0.002 mg/L	ADWG
Non-potable use	0.02 mg/L	DOH
Provisional Tolerable Monthly intake	25 µg/kg BW	JECFA
Leafy vegetables	0.1 mg/kg	ANZFSC (2017)– Schedule 19
Root and tubular vegetables	0.1 mg/kg	
Molluscs	2 mg/kg	
HIL-A Residential Soils	20 mg/kg	ASC NEPM (2013)

Note: meat is excluded as assumption is it is imported to Christmas Island

This document can be made available in alternative formats on request for a person with disability.