

HEAVY METALS AND CANCER

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What are heavy metals?

Heavy metals are a subgroup of metals with a high mass to volume ratio. For example, some have identified a density of at least $5\text{g}/\text{cm}^3$ (five times the density of water) to qualify as a heavy metal.¹ Arsenic, cadmium, chromium, lead, and mercury have been studied within a diverse context of diseases, including cardiovascular disorders, neuronal damage, renal injuries, cancer, skin conditions, and organ failure.²

What heavy metals are considered carcinogenic?

The International Agency for Research on Cancer (IARC) is a major authority on defining a host of exposures' carcinogenicity, by extensively reviewing the literature published to-date. The IARC has published a series of monographs detailing the evidence on the association between specific heavy metals and cancer. Based on a pre-determined set of criteria,³ the IARC categorizes agents into four groups of carcinogenicity:

Group 1. Carcinogenic to humans

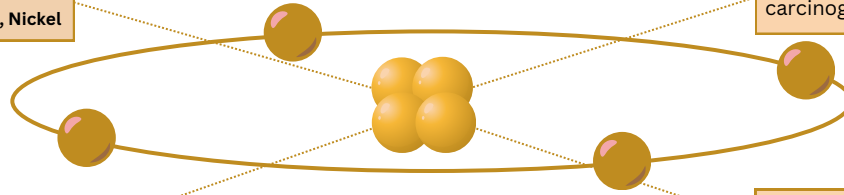
- Arsenic, Cadmium, Chromium(VI), Nickel

Group 3. Not classifiable as to its carcinogenicity to humans

Group 2A. Probably carcinogenic to humans

Group 2B. Possibly carcinogenic to humans

- Mercury



The International Agency for Research on Cancer (IARC) categories for carcinogenic agents.

How do heavy metals increase your risk of cancer?

The specific mechanisms by which heavy metals have been hypothesized to initiate cancer growth vary by cancer type. The heterogeneity of cancer types make defining overarching heavy-metal-related carcinogenic pathways difficult. However, some cancers have been studied more closely; the figure below presents heavy metal-cancer type associations and corresponding carcinogenic mechanisms:⁴

As
Arsenic
74,82159

Arsenic and inorganic arsenic compounds.
Skin (other malignant neoplasms), urinary bladder, lung cancer.



Oxidative DNA damage, genomic instability, aneuploidy, gene amplification, epigenetic effects, DNA-repair inhibition leading to mutagenesis.

Cd
Cadmium
112,411

Cadmium and cadmium compounds.
Lung cancer.



DNA-repair inhibition, disturbance of tumour-suppressor proteins leading to genomic instability.

Cr
Chromium
51,9961

Chromium (VI) compounds.
Lung cancer.



Direct DNA damage after intracellular reduction to Cr(III), mutation, genomic instability, aneuploidy, cell transformation.

Ni
Nickel
58,6934

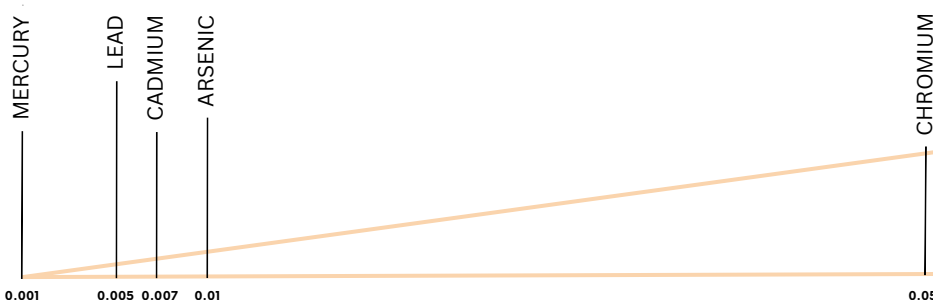
Nickel compounds.
Nasal cavity, paranasal sinus and lung cancer.



DNA damage, chromosome aberrations, genomic instability, micronuclei, DNA-repair inhibition, alteration of DNA methylation, histone modification.

List of Group 1 heavy metals, associated cancers with sufficient evidence in humans and established mechanistic events.

What levels are considered safe?



Maximal acceptable concentrations for heavy metals in drinking water. Numbers expressed in mg/L.⁷⁻¹¹

HIGH-RISK GROUPS



ARSENIC

Workers who produce or use arsenic compounds in vineyards, ceramics, glass-making, smelting, refining of metallic ores, pesticide manufacturing and application, wood preservation, semiconductor manufacturing.⁵

CADMIUM

Main sources of exposure include primary metal industries, emissions from industrial activities including mining, smelting, manufacturing of batteries, pigments, stabilizers, alloys,⁶ electroplating, storage batteries, vapor lamps and solders. Cigarette smokers are also exposed to higher levels of cadmium compared to non-smokers.⁶

CHROMIUM

Chromium-induced diseases in industrial workers occupationally exposed to Cr(IV): manufacturing of cars, glass, pottery and linoleum.⁶

LEAD

Children living in homes with deteriorating lead paint,⁵ lead production workers, battery plant workers.⁶

COBALT

Exposure in the manufacture of jet engines.⁶

MERCURY

Dental assistants, hygienists, chemical workers.¹

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