

# Arsenic: Human Exposure and Impact on Environment

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**Abstract** - Arsenic is a naturally occurring metalloid and is highly toxic in its inorganic form. It is a component of earth's crust and is distributed widely throughout the environmental resources such as water, air and land. Owing to its toxic nature, exposure to arsenic can be hazardous and is reported to be a confirmed carcinogen and a significant risk factor for cancer. The human exposure to arsenic can be attributed to contaminated air or drinking water, certain foods, cigarette smoking and occupational environment. A great threat to human health maybe posed by the arsenic-contaminated water used for irrigation of food crops, drinking and food preparation. However, drinking water remains the major source of arsenic poisoning worldwide. Arsenic in drinking water in its inorganic form and is reported to be absorbed and metabolized easily, thus posing a serious health hazard. However, arsenic content found in sea foods is organic in form and is comparatively less harmful. Long term exposures can result in chronic arsenic poisoning, leading to skin lesions and skin cancers as reported by various studies. WHO has listed arsenic as one of 10 chemicals posing public health concern. Therefore, a thorough knowledge of nature, sources, and effect of arsenic on human health as well as environment is imperative.

**Index Terms** - Arsenic contamination, carcinogen, contaminated water, Arsenic poisoning.

## INTRODUCTION

Arsenic is a metalloid which is a natural component of earth's crust and is widely distributed throughout our environment- water, air, and land [1]. As arsenic has the capability of attaching to very small particles in air, it can travel long distances and can stay in the air for a longer time [2]. Arsenic may be present in the environment in two forms- inorganic and organic. While inorganic form is highly toxic and hazardous to human health if exposed to, organic form is comparatively less toxic.

## SOURCES

Arsenic is present in our environment in various sources such as drinking water, various foods, industrial products, pharmaceutical drugs, electronics, and batteries amongst others. [3] Contaminated drinking water (ground water) is the major source of arsenic exposure in humans. Various countries naturally have very high levels of inorganic arsenic in their groundwater as various arsenic compounds present in industrial wastes can dissolve in water leading to water contamination [4], [5], [6]. This water is also used to irrigate crops and thus arsenic contamination of the food results as well [7]. Other dietary sources of arsenic are meat, dairy products, shellfish, poultry, and certain cereals. Although arsenic exposure is lesser with these foods compared to groundwater as the arsenic in these foods is present in its lesser toxic organic form. Studies have reported arsenic content in tobacco of cigarettes, so the cigarette/cigar/hookah smoke inhaled does too and smokers present with inability to methylate ingested arsenic, show a synergistic effect [8]. Various industrial materials and wood preservatives such as antifungal agents also have arsenic content. Elemental arsenic is used in the manufacture of alloys, particularly with lead (e.g., in lead acid batteries) and copper, semiconductor and electronics industries. However, taking cognizance of toxic effects, the use of arsenic compounds has declined in last two decades.

Exposure to high levels of arsenic in drinking-water has been found for many decades in some regions of the world, like China and some countries of South America. In most of these regions, the drinking-water source is groundwater which is naturally contaminated from arsenic-rich geological formations. The primary regions where high concentrations of arsenic have been measured in drinking-water include large areas of Bangladesh, China, West Bengal (India), and smaller areas of Argentina, Australia, Chile, Mexico, Taiwan (China), the USA, and Viet Nam. In some areas of Japan, Mexico, Thailand, Brazil, Australia, and the USA, mining, smelting and other industrial activities have contributed to elevated concentrations of arsenic in local water sources [9].

Soils contaminated with arsenic from anthropogenic sources (e.g., mine/smelter wastes, agricultural land treated with arsenical pesticides) can have very high concentrations of arsenic up to several grams per kilogram [10].

## HUMAN EXPOSURE AND NEGATIVE EFFECTS

The primary source of arsenic exposure for the general population is via the ingestion of contaminated food or water. Naturally occurring sources are weathering of minerals and ores, and inhalation of atmospheric gases and dusts. Several industries such as, sawmills and wood preservation, construction, farms, non-ferrous metal (except aluminum) production and processing, iron and steel mills and ferro-alloy manufacturing, oil and gas extraction, metal ore mining, glass and glass-product manufacturing, semiconductor manufacturing, and basic chemical manufacturing are notable sources for Arsenic contamination [11].

Arsenic exposure is a serious health threat worldwide. Long term exposures to arsenic due to contaminated drinking water, foods and contaminated air may lead to chronic side effects [12] Inorganic arsenic has been reported to be a known carcinogen and is one of the 10 chemicals posing serious health threat according to a report by WHO. Arsenic exposure may have acute effects and long-term chronic effects. Acute arsenic poisoning can have some serious immediate effects such as abdominal cramps, vomiting, and diarrhea followed by tingling sensation and numbness in the extremities with cramping of muscles. There can be gastrointestinal, cardiovascular, neurological, renal, dermal, hemopoietic, hematological and reproductive effects of varying severity due to arsenic exposure. In humans, chronic arsenic ingestion may cause cancers of the skin, lung, liver, bladder, prostate, and kidney [13], [14].

**IMPACT ON ENVIRONMENT**

Many countries worldwide have declared arsenic pollution to be an important environmental issue, especially during the last decade. Groundwater contaminated with arsenic content has become an extremely rising concern among various countries in the world vis-à-vis its use for irrigation of the crops, therefore arsenic entry into the food-chain through various food crops and fodders [15], [16]. Inorganic arsenic content of food determines the level of health hazards to animal and human health. In plants, photosynthesis is affected due to exposure to arsenic, thereby inhibiting growth and reproduction. Contaminated water bodies show lesser aquatic life. Also, as inorganic arsenic can bind to the smaller particles in air, they tend to travel longer distance and for longer periods of time. Due to the widespread contamination of all environmental sources- air, water and land- arsenic is a highly potent environmental polluter posing serious health threats.

**CONCLUSION**

Arsenic is abundantly present in crust of the earth and is widely distributed throughout the environment. Contamination of water especially groundwater with inorganic arsenic poses a serious health threat to humans and can lead to various hazards, dermal effects being the most prominent ones. Arsenic is a known carcinogen and is known to cause skin cancers. Therefore, remedies are essentially to be applied such as substitution of high-arsenic sources with low-arsenic ones, such as groundwater with rainwater and treated surface water. Low-arsenic water can be used for drinking, cooking, and irrigation purposes. Long term actions are required to reduce arsenic exposure to optimum for safeguarding plant, animal, and human health.

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