

Editorial**Arsenic Poisoning on Human Health****Ahmed Naveed Bhatti***Association of Family Physician of Pakistan***Abstract:**

Introduction: The harmful effects of arsenic (As) to humans have been evaluated by government agencies in different countries around world. The maximum allowed level of arsenic is 50 to 25 µg/L but these agencies has lowered this level due to its bad effects.

Methodology: In U.S. this is from 50 to 10 µg/L. The excessive intake of As and dreadful human health effects is very serious issue nowadays and here we discuss summary of some of the major effects as listed in the scientific literature. To discuss the effects of arsenic we focus on the route through which it comes in contact with humans. There are two points to be focused: To monitor the concentration of arsenic in drinking water. Observance of arsenic exposure biologically.

Results: The techniques atomic fluorescence spectrometry, atomic absorption spectroscopy (AAS) used for accurate measuring of concentration of arsenic. The ill effect of arsenic on human skin, human immune system, and respiratory systems has been observed as worst and chronic now a days. People from different areas have been observed medically and statistical data analysis was done and reported as alarming situation. Humans are at high risk.

Conclusion: We can take arsenic from our food and water. These harmful effects can be treated completely in one way but in certain ways may be it is impossible. So, we should be careful for our food and health.

Key words: Atomic, fluorescence, spectrometry, atomic absorption, spectroscopy

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INTRODUCTION:

The poisoning effect caused by arsenic is usually due to toxicity and biochemistry of arsenic in living systems. The two cancer causing active forms of arsenic are trivalent and pentavalent arsenic compounds. The more specific forms of arsenic can cause single cell poisoning.

This toxicity effect of arsenic is due to the inhibition of sulfhydryl containing enzymes. The trivalent arsenic compound is more actively effected in vivo oxidation_ reduction reactions. This is also known as arsenolysis (Hong, Song *et al.*, 2014).

There are two types of poisoning caused by arsenic

- (a) Acute Poisoning
- (b) Chronic poisoning

Severe nausea, vomiting, diarrhea are symptoms of acute poisoning. This acute poisoning leads to chronic one.

The melanosis, hyperkeratosis and desuamation are the symptoms and the results of chronic poisoning. Anemia and leukopenia are main symptoms with chronic exposure. Anemia is normocytic and is caused by hemolysis. Peripheral neuropathy is also hallmark of chronic exposure. The resorption of myelin axonal destruction is done in this situation and leads to nerve atrophy and perineural fibrosis (Khan, Owens *et al.*, 2009)

In USEPA the most prior pollutants are listed and inorganic arsenic is listed as the number one pollutant. Arsenic poisoning is accepted as the significant global health problem. In India and Bangladesh about 60_100 million people are at risk. In certain areas of PR china arseniosis is the most prevalent.

China has rich source of coal. The major pathways have been associated with ingestion

of food. The highest tumor incidences were found in lungs and intestinal tract of mice and 3.3 percent of the mice skin has cancer. This experiment was done on mice to check the dose rate which is similar to dose range in Bangladesh (Khan, Owens *et al.*, 2009).

The chronic human health effects caused by arsenic were important in the US panel. The effects of arsenic by drinking water include skin lesions, hyper pigmentation and respiratory symptoms such as cough are confirmed by the National Research Council (NRC).

The NRC reported that kids and children are at high risk may be affected as cancer or non cancer due to greater consumption of water. Water is the main pathway for arsenic poisoning. Heavy metals are dissolved in water and due to inappropriate sewerage system drinking water is polluted with such dangerous metals.

Canada and Pakistan are also at the top of the list i-e contamination of drinking water. The highest concentration of water is 5¢g/L.

Methodology for evaluating the exposure of arsenic in humans:

Pathway for Contamination exposure identification including the harmful effects on the human health is the basic interest in risk assessment of environment.

Risk assessment of environment displays both quantitative and qualitative explanation of the pathway of the exposure through which an agent travels towards receptor from a source and provides information about the interaction between agent and transport medium (Khan, Owens *et al.*, 2009). To evaluate the exposure of arsenic in humans following basis are considered.

Table 1: Comparison of arsenic occurrences in groundwater from selected parts of the world (Courtesy of Naidu and Bhattacharya).⁽¹⁹⁾

Country/Region	Area affected	Depth of well	Arsenic conc. ($\mu\text{g/L}$)	Mechanism of contamination
Bangladesh, BDP (52 districts)	118,012 km ²	8-260 m	<2→900	Reduction of Fe-oxyhydroxides/Sulfide oxidation(?) in alluvial sediments
West Bengal, India, BDP (8 districts)	34 000 km ²	14-132 m	<1-1300	Reduction of Fe-oxyhydroxides/Sulfide oxidation (?) in alluvial sediments
China, Xinjiang Inner Mongolia (HAB)	4800 km ²	Shallow/Deep	<50-1860	Reducing environment in alluvial sediments
Taiwan	—	Deep	Up to 1820	Oxidation of pyrite in mine tailings
Thailand (10 districts)	10 districts	Shallow	120-6700	Oxidation of mine wastes and tailings
Ghana	1600 km ²	70-100 m		Oxidation of arsenopyrite in mine tailings
Argentina (Chaco-Pampean Plains)	10 million km ²	Shallow aquifers	100-4800	Volcanic ash with 90% rhyolitic glass
Chile	—	Shallow and deep wells	100-1000	Volcanic ash
Mexico, Zimapan, Lagunera	—	Shallow and deep wells	300-1100	Oxidation of sulfide from mine wastes
Hungary (Great Hungarian Plain)	4263 km ²	80-560 m	25→50	Complexation of arsenic with humic substances
USA	Large areas	53-56 m	100→500	Desorption of arsenic from Fe-oxyhydroxides/Sulfide oxidation
Canada (Nova Scotia)	—	8-53 m	18-146	Oxidation of sulfides
United Kingdom (Cornwall)	—	Shallow wells	>10	Oxidation of sulfides from mine wastes

1) To monitor the concentration/quantity of arsenic present in drinking water.

2) Observance of arsenic exposure biologically (Kapaj, Peterson *et al.*, 2006)

Concentration/quantity of As(arsenic) present in water that is used for drinking purpose

To evaluate the arsenic (As) exposure in human beings and its concentration in drinking water 4 methods are being prescribed.

In 1st(first) method concentration or quantity of arsenic(As) present in water that is used for body can be effected by the temperature of air and humidity.

The 2nd (second) method concerns with daily routine burden of arsenic (As) on individual's body that is based on the consumption of the specific quantity of intake of drinking water.

The (third)3rd method is centered upon the average arsenic exposure. This can easily access the linkage in-between the arsenic exposure also and the terrible.

The harmful effect on health including various types of cancers that can occur after a long duration exposure.

4th (Fourth) method is a combined index of arsenic(As) exposure that is suitable for those cases in which level of arsenic present in water that is used for drinking has changed and in which least level of arsenic(As) exposure persist for long duration (Kapaj, Peterson *et al.*, 2006) (Styblo, Yamauchi *et al.*, 1995).

drinking is considered as mark for As exposure but this doesn't explains the

exact volume consumed by the individual and explains the current and present exposure with only short duration harmful effects with no concern with long duration effects.

The 2nd (second) method concerns with daily routine burden of arsenic (As) on individual's body that is based on the consumption of the specific quantity of intake of drinking water. This daily consumption by an individual's

Figure 1: Arsenic(As) exposure via water utilized for drinking purpos

For accurately measuring the concentration and quantity of As(arsenic) present in drinking water, a well trained staff and expensive instrumentation are required.

The techniques include atomic fluorescence spectrometry, ICP(inductively coupled plasma) AAS(atomic absorption spectroscopy) and ICP/MS(mass spectrometry).

Such techniques generate limits for detection below As(arsenic) WHO guidelines as 10 ppb, and instrumentation is laboratory based.

These are based on time consumption but not effective for the monitoring of vast quantity for samples. (Luong, Majid *et al.*, 2007).

Biological observance of Arsenic (As) Exposure

Water utilized for drinking present in well contains inorganic arsenic (As) including trivalent and pentavalent state of oxidation.

Arsenic (As) that is inorganic in nature is metabolized in a 2 stepwise methylation and cumulative concentration of the inorganic arsenic (As).

The mono-methyl-arsonic acid (MMA) as well as dimethyl-arsenic acid (DMA) are preferred to be used for biomarkers for arsenic(As) exposure.²

For the study of comparison of in vitro methylation of pentavalent and trivalent arsenic(As), the methylation of trivalent arsenic is done more rapidly as compared to pentavalent arsenic(As) containing compounds (Styblo, Yamauchi *et al.*, 1995).

4(four) methods are common for the biological observance of arsenic exposure. In

1st method the determination of the concentration of arsenic (As) is done. Firstly there is the determination of the quantity/concentrations of arsenic(As) present in urine that is voided as arsenic present in urine is considered as a good index for the estimation of exposure of As.

Concentration/quantity of arsenic present in the urine in specific population of united states was monitored as they were exposed to arsenic that is inorganic in nature and was observed to be in the range of about 8-620 microgram per liter.

There is a strong linkage between the urinary arsenic concentration and concentration of arsenic that is inorganic that is present in water utilized for drinking. Second method is based on the measurement of the quantity/amount of arsenic in the blood. Peripheral blood sample is preferred for the observance of arsenic exposure.

Urine and blood samples depicts individual's arsenic intake and external contaminants including hands, dust and contaminated water does not affect these samples.

3rd(Third) method explains amount/quantity of the As present in the hairs.

Samples of hairs are considered as biomarkers for the exposure of arsenic as DMA and inorganic As residing in the hair root and show exposure of past.

4th method estimates amount and concentration of arsenic(As)

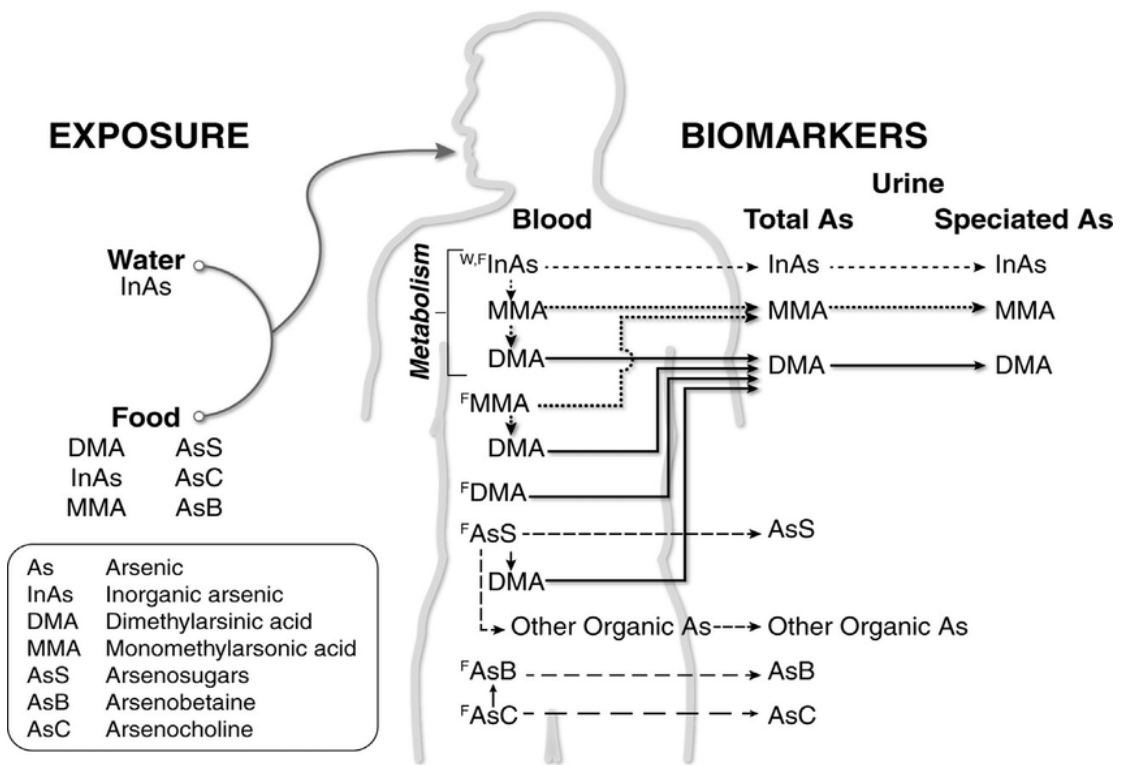


Figure 2: Arsenic forms in biomarker measurement present in diet and water.

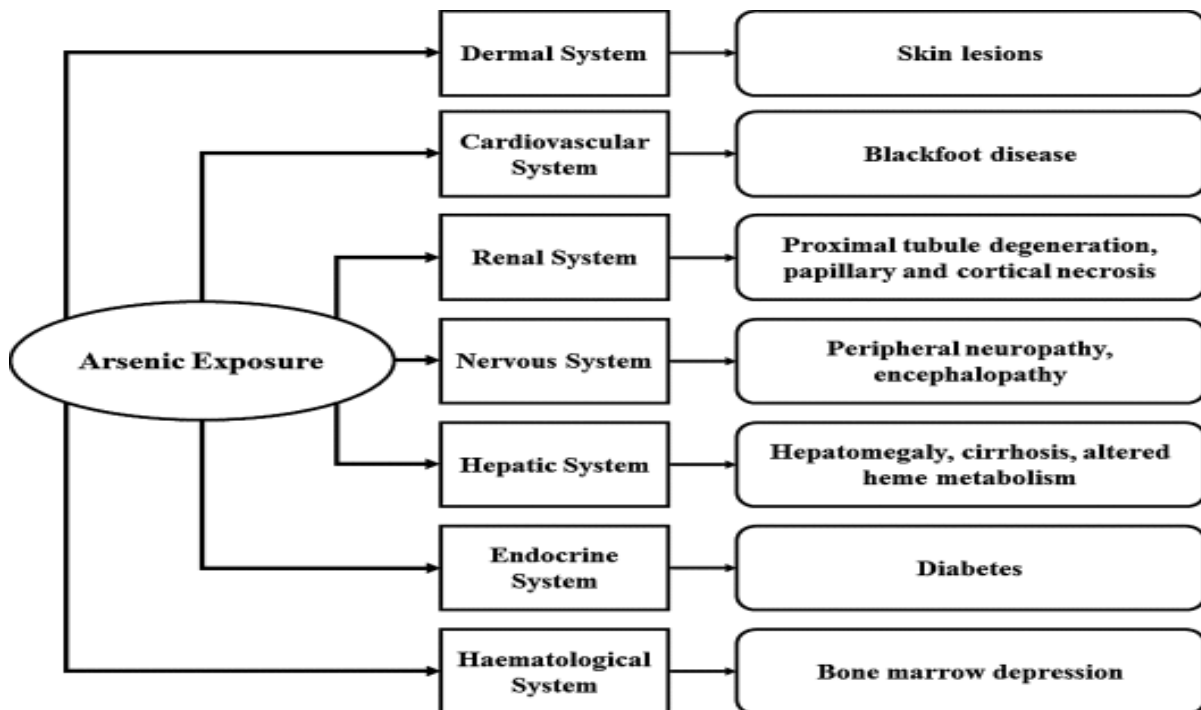


Figure 3: Arsenic exposure cause human disease

present in nails as nails of fingers and toes are utilized for these have As as 3 month before in the fingers and six(6) months before in the toes. Considering this that nails as well as hairs are preferred for the biomarkers for the estimation of As exposure average (Hong, Song *et al.*, 2014).

Results:

Arsenic is very dangerous heavy metal and its concentration in our body is increasing day by day. It is affecting our body in many different ways some of them are mentioned below. Figure 4 showing that every system of human body is suffering after its exposure to arsenic. Figure 5 is showing that when arsenic enters into body then organs passes through four fatal stages.

Effects of arsenic on human skin:

Skin is the largest organ of human body. The chances of its exposure to pathogens and external environment are high. Abnormalities in skin are mostly observed in adults (Lindberg, Rahman *et al.*, 2008). Men are more prone to get affected by arsenic as compared to women (Rahman, Ng *et al.*, 2009).

Arsenic can affect skin in much way. It can cause skin lesions that appear on skin after 5-10 years of arsenic exposure. Skin lesions include presence of pigmentation on skin, the pinkish lining of large intestine turned brown or black (Rahman, Ng *et al.*, 2009).

It is also cause of appearance of small bumps on the skin. A study was conducted in west Bengal in which they studied 156 patients and they also complained of stiffness of palm and sole in about 66% of patients (Mazumder, Santra *et al.*, 1998).

Effects of arsenic on nervous system:

Brain is the main target for arsenic poisoning. The main reason is that arsenic can cross

barrier between blood and brain (Munday, Roy *et al.*, 2013).

In brain it distributes in all parts of brain. Maily itattacks pituitary gland(Sánchez-Peña, Petrosyan *et al.*, 2010).

Health condition become worse and and reaction is very quick due to actue and chronic exposure of brain tothis heavy metal. Neurons having long axons and sensory nervesare more affected by arsenic as compared to motor neurons and neurons of small endings(O'Bryant, Edwards *et al.*, 2011).

Figure: it is showing neurotoxicity due to arsenic. That how arsenic affects neurons and major parts of brain.

Effects of arsenic on respiratory system:

Arsenic can enter into hman body by drinking water or through work place and cause serious complications in respiratory track also. In a study held in Bangladesh mortality rate due to consumption and exposure of arsenic has been increase to high level. Lungs lost their function because of adverse effects of arsenic on lungs (Argos, Kalra *et al.*, 2010).

Arsenic fumes produced during minning can cause cimplications in lungs and can lead to infections of lynrx, bronhitis (Parvez, Chen *et al.*, 2011).

Effects of arsenic on immune system:

Arsenic has very adverse **effects** on all cells of immune system. Due to its **entrance** into body innate immunity disturbs (Srivastava, Li *et al.*, 2013). It suppress immune system in one or other way.

The proliferation umber of immune cells becomes directly proportional to dose of arsenic (Srivastava, Li *et al.*, 2013).

In all immune cells macrophages are main target and play vital role in immunotoxicity. Macrophages lose their capability of adhesion

and become round. Due to which body becomes more prone towards attack by pathogens.

Effects of arsenic on reproductive system:

It affects development of fetus inside mother's body. It can create obstacles in growth of fetus and can lead to ultimately death of it. It affects both males and females sex organs equally. Higher concentration of arsenic can lead to gonadal dysfunction and death of cells. It is also main reason of problems occur during pregnancy in females and can lead to fetal loss.

Conclusion:

Arsenic poisoning is increasing day by day. The main source of exposure are natural sources. If contaminated water is taken for long period of time then it can cause skin problems. It can be ingested through food. Humans are at high chances of being affected by arsenic than animals.

Poor people are at high risk of being affected by arsenic fumes, water due to malnutrition. Not all complications caused by arsenic can be treated well. It can damage nearly all organs of human body. It can be able to convert normal cells into cancerous cells and also can produce epigenetic effects. Cancer can be developed into bladder, kidney, lungs, skin and prostate gland. There is no known medicine present to treat complications caused by it. Only arsenic free water can help.

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