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# The possible correlation between environmental arsenic exposure and coronary heart disease: cross-sectional analytical study

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**Abstract**

**Background:** In industrialized countries, where human health is threatened by a number of environmental pollutants, particularly heavy metal contaminants, cardiovascular diseases (CVD) are primary public health concerns that are highly widespread. These societies have a high incidence rate[1]**.** Our goal was to investigate whether a connection exists between exposure to arsenic and coronary heart disease (CHD). **Aim of work**: to identify the possible correlation between arsenic exposure and coronary heart disease in a sample of Egyptian population. **Patients and methods:** All participants (90 participants) 45 cases and 45 control completed a questionnaire about their lifestyle and dietary habits and blood samples were drawn under aseptic conditions to evaluate arsenic blood levels by atomic emission spectroscopy samples collected from cardiology department at Cairo University hospital. **Results:** This current work demonstrated statistically significant higher levels of arsenic in cases than in control. Arsenic exposure risks were significantly higher in coronary heart disease patients than in control participants. **Conclusion**: The current work suggested a relation between arsenic blood levels and coronary heart disease.

**Keywords:** Arsenic, coronary heart disease, heavy metal, environmental.

**Introduction:**

Since many decades ago, the topic of exposure to heavy metals has been of concern to the public health community. Numerous in-depth studies on these metals and the hazardous effects they have had on the environment have been carried out and regularly reviewed by international organizations [2]The level of pollution has been brought about as a result of rising urbanization, industrialization, population growth, and an overall desire on the part of humans to abuse Mother Nature.

According to [3]**,** the toxicity, persistence, and accumulative behaviour of heavy metals can cause damage to the diversity of marine species, as well as to ecosystems, and ultimately can be absorbed by humans, resulting in health hazards. This damage can be caused when heavy metals are dumped into marine environment.

The World Health Organisation (WHO) reports that cardiovascular disease (also known as CVD) is the leading cause of mortality worldwide, accounting for nearly one-third of all deaths. According to 4 research, both epidemiological and experimental evidence points to the possibility that metals and metalloids such as arsenic have a role in CVD. Because people are exposed to these harmful substances so frequently, the subject of their effects on human health is currently receiving a great deal of attention.

The most pervasive environmental toxin is arsenic. Arsenic is therefore given top priority on the Agency for Toxic Substances and Disease Registry's (ATSDR) list of hazardous substances. Every day, arsenic enters our bodies through our food and water [5]**.**

Arsenic is mainly released naturally, such as through weathering, mineral dissolution, and volcanic activity, as well as the mixing of geothermal fluids with groundwater in shallow areas.The speed of this process is increased by human activities such as agriculture, mining, and the use of hydrocarbons, geothermal energy, and coal. Arsenic can pollute ground and surface water, affecting drinking water quality and crop yield through contaminated irrigation water. It can also contaminate soil, living organisms, and the air when it is emitted from natural or human-made sources. [6]

Water and seafood, especially shellfish, are the main sources of human exposure to arsenic. According to[7] **,** arsenic can be found in the environment in both inorganic (IAs) forms (AsIII and AsV) and organic forms (MMA, DMA, arsenobetaine, and arsenocholine).

**Methods:**

Ninety people were enrolled in this case-control study, 45 of whom had coronary artery disease (CAD) and were undergoing coronary angiography at Kasralainy Hospital's cardiology department, and 45 of whom had fully normal electrocardiograms. All participants gave their informed consent before taking part in the study and having blood drawn. The study was sanctioned by the Medical University of Cairo's Ethical Committee. Coronary angiograms were performed using routine procedures. Lifestyle and dietary history were taken from all participants including fish consumption and type of water intake. Lipid profiles were investigated for all participants.

**Results**

The mean age of cases was 59.09 ± 10.12 while the mean of the control group was 61.2± 8.67 with no statistically significant difference (p=0.291).

Regarding gender distribution in our study males were 77.8%(n=35) of cases but

22.2%(n=10) were females. In control group 66.7%(n=30) were males and 33.3%(n=15) were females.

Regarding smoking status 77.8% of cases (n=35) were smokers & 22.2% (10) were nonsmokers. Concerning control subjects 71.1% were smokers and 28.9% were nonsmokers. There was no statistically significant difference between the cases and the control group (p-value = 0.212).

Regarding fish consumption 13.3% of cases eat fish less than time per week and 86.7% of cases 1 or 2 times per week but control subjects (35.6%,64.4%) respectively. So there was a statistically significant difference between coronary heart disease patients and the control group in fish consumption.

Regarding the type of water 86.7% of cases consume tap water but 13.3% consume filtered water and no statistically significant difference between cases and control as p value= 0.561.

Regarding mean blood levels of arsenic in cases was 0.22±0.43 in control group was 0.02±0.02 with p-value <0.001so there was a statistically significant difference between cases and control participants as shown in **Figure 1.**

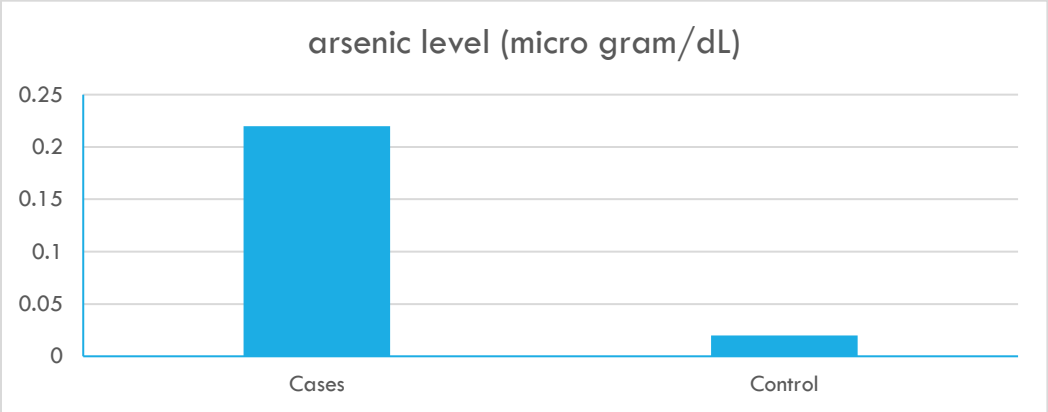


**Figure (1) arsenic blood levels in cases and control participants.**

There was no statistically significant correlation between age and blood arsenic with a p-value of 0.3. There was no statistically significant correlation between gender and arsenic with a p-value of 0.06. as shown in **table 1.** There was a positive correlation between the mean arsenic level and the number of cigarettes in smokers per day with p-value (0.001) by the Kruskal-Wallis test as shown in **Table 2.**

**Table (1) Correlation between blood arsenic levels and gender**

| | **Male n=35** | **Female n=10** | **p value** |
|---|---|---|---|
| **Arsenic blood levels** | 0.56±1.96 | 0.05±0.14 | 0.06 |

**Table (2) Correlation between number of cigarettes and arsenic blood levels.**

| | number of cigarettes | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | no | | 9 cigarettes per day | | 10 to 20 cigarettes | | more than 20 per day | | P value |
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation | |
| arsenic level (micro gram/dL) | 0.10 | 0.20 | 0.17 | 0.20 | 0.69 | 0.78 | 0.09 | 0.26 | 0.001 |

Regarding lipid profile there was no statistically significant correlation between serum lipid profile and arsenic blood levels as shown in **table 3.**

Also, there was no statistical significant correlation between arsenic blood level and fish consumption times per week in our study by spearman correlation with p values 0.12.

**Table (3): Correlation between blood metal levels (lead, cadmium, arsenic and mercury) and serum lipid profile(LDL,HDL ,Cholesterol &TG)**

| | | arsenic level (micro gram/dL) |
|---|---|---|
| cholesterol | Correlation Coefficient | 0.014 |
| | P value | 0.925 |
| | N | 45 |
| LDL | Correlation Coefficient | 0.053 |
| | P value | 0.729 |
| | N | 45 |
| HDL | Correlation Coefficient | -0.117- |
| | P value | 0.445 |
| | N | 45 |
| TG | Correlation Coefficient | -0.261- |
| | P value | 0.083 |
| | N | 45 |

**Discussion:**

There is growing concern regarding the possible link between long-term exposure to trace amounts of heavy metals and cardiovascular disease (CVD). Traditional risk factors for cardiovascular disease can only account for a small percentage of the disease burden. This gap calls attention to the necessity of identifying new indicators that can predict the occurrence of cardiovascular disease and/or the severity of the disease [8]

Environmental exposure plays a significant role in the development and severity of cardiovascular disease (CVD), but it is often overlooked as a risk factor. The heart and vascular system are highly susceptible to various environmental agents, including ambient air pollution and metals. Like traditional risk factors such as smoking and diabetes mellitus, these exposures contribute to the progression of disease and increased mortality by either enhancing or initiating the pathological processes associated with CVD. [9]**.**

Regarding the demographic data of the present study mean age of cases was 59.09 ± 10.12. Males were 77.8%(n=35) of cases but 22.2%(n=10) were females but in control group 66.7%(n=30) were males and 33.3%(n=15) were females.

According to the findings of [10] who conducted a population-based cohort study of Swedish men and women between the years 1991 and 1994 to investigate the association between blood cadmium levels and the occurrence of incident cardiovascular events. Cases analyzed ranged in age from 50 to 64 years old on average. In addition to this, according to [11], who conducted a study using a random sample of urban people in the southern region of Brazil, the age range of the cases that were evaluated was 40 and older.

Gender distribution in our study 77.8% of cases were males and 22.2% were females but 51% were women in [12]&44.4% were men in [11.]

Regarding comparative arsenic levels between the two studied groups, Blood levels of arsenic were significantly higher in cases *vs.* control subjects with highly statistically significant differences correlating with cohort study done in Bangladesh [14].They investigated the effect of arsenic-contaminated drinking water on children aged 5-18 years during 2003-2010. They found that there was an increase in childhood deaths which were related to cardiovascular abnormalities.

Regarding smoking status**,** a strong association between arsenic mean blood level and the number of cigarettes consumed per day and was on the same line as several previous studies such [15], and [11]

**Conclusion**

The current study suggested a possible link between toxic heavy metals levels and the presence of coronary heart disease

**Recommendation**

The findings of this study should motivate further environmental research to be conducted in Egypt to evaluate the amounts of arsenic found in the country's air, water, and food products. This would allow for a better correlation between biological monitoring and environmental monitoring.

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