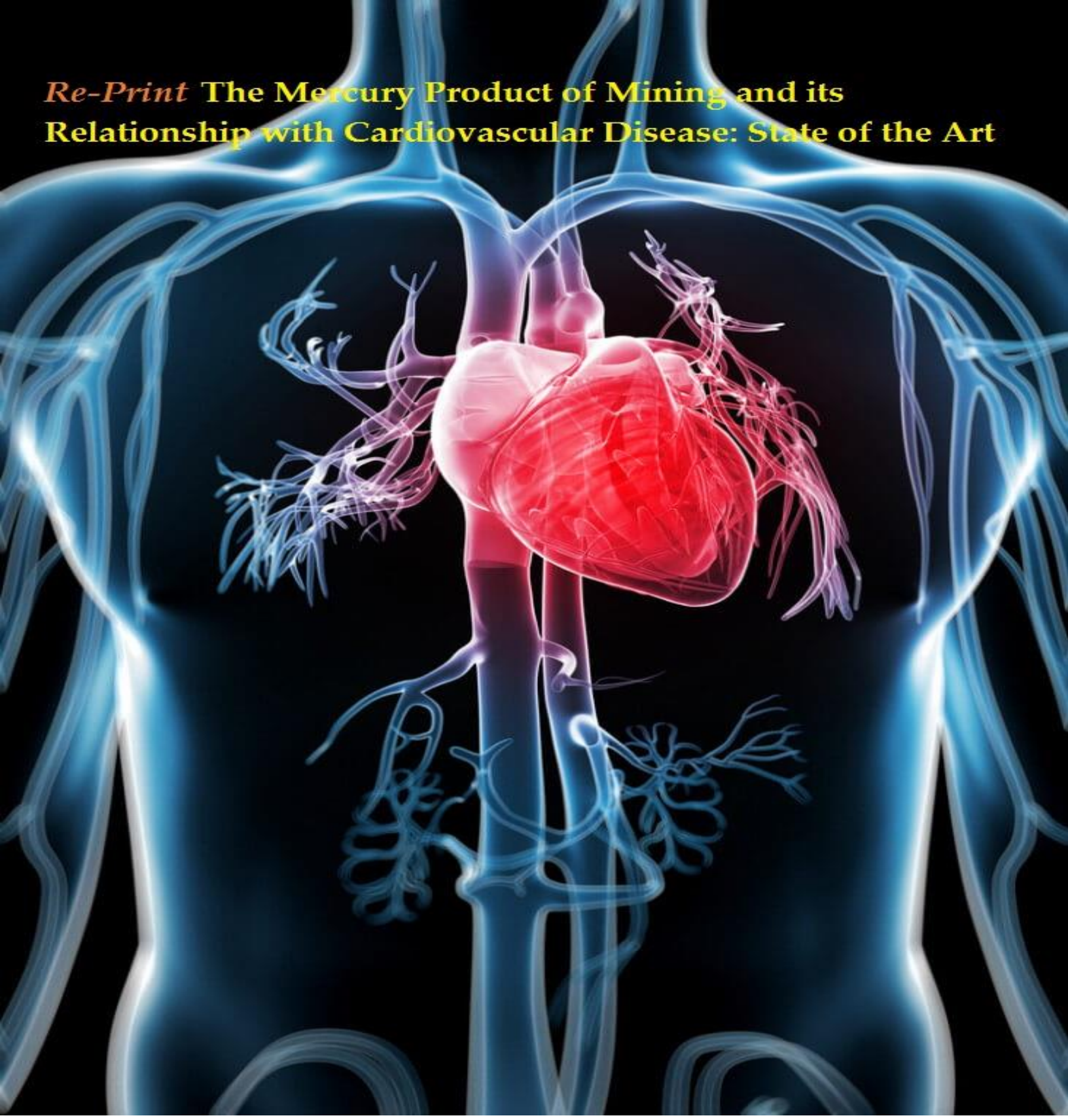
Re-Print **The Mercury Product of Mining and its Relationship with Cardiovascular Disease: State of the Art**



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Research Article

Re-Print-The Mercury Product of Mining and its Relationship with Cardiovascular Disease: State of the Art

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Abstract

It is clear, according to the literature, mercury from mining, in its methylmercury form, produces neurotoxicity and decreased IQ in fetuses; However, there are several reviews and studies on the association of mercury with cardiovascular diseases, because these are the cause of greater morbidity and mortality worldwide; it is necessary to clarify their relationship, as the purpose of this state of art. These documents were reviewed, analyzed and synthesized to define said association; within which, a meta-analysis was found that reviews 37 studies and concludes that there is no association of mercury with cardiovascular diseases and that on the contrary; lead, arsenic, cadmium and copper, if they have a strong relationship with cardiovascular disease.

Keywords: Mercury; Mining; Cardiovascular disease; State of the art

Introduction

There is no history of developed articles, such as the State of Art related to Mercury, the product of Mining and its relationship with Cardiovascular Disease, that is, the state of the matter, which is "to create a new field of research, not only with the expansion of documentation, but the conversion of research into research phenomenon itself; consequently, one could talk about research on research" [1]. And with this, shred the information acquired and build new information in order to produce a change that improves the standards of knowledge in order to transform a reality towards a solution that produces a positive impact in this case on the person's health. What makes it an original article? The purpose of this State of Art is to raise awareness of the association of Mercury due to Mining and Cardiovascular Disease and to answer the following question: Does Mercury from Mining is related to Cardiovascular Disease? In 2017, the World Health Organization ruled on Artisanal and Small-scale Gold Mining (MAPE) and its association with health and environmental problems, as a background to the Mercury Minimata Agreement in October 2013; There are millions of people dedicated to this work in developing countries that consequently affect their health [2] Diseases such as: Neurotoxicity and the decrease of the IQ of children of pregnant mothers, exposed to said metal, in addition to cardiovascular effects particularly with one of the toxic forms of mercury: Methylmercury [3].

This is a public health problem because the World Health Organization requires that in 2012 17.5 million people died due to cardiovascular diseases, which represents 30% of deaths registered in the world and predicts that by 2030; 23.6 million people will die of some cardiovascular disease, also makes reference that it will continue to be the leading cause of death [4]. In the United States, health policies for the control of mercury contamination have demonstrated long-term economic benefits with domestic control policies than with control policies determined at the Minimata convention in November 2013 [5]. In Mojano (Colombia) there are several small-scale artisanal gold mines, where mercury is used as part of the process to obtain gold. A loss of 1 to 2 grams of mercury is calculated by obtaining 1 gram of gold. Mojano is comprised of four departments and is a crucial area for environmental regulation and ecological balance; 70% of families in Mojano are poor; 57% of residents live in conditions of extreme poverty and 87% of them do not have basic needs and it has been shown that they have health problems due to exposure to mercury both workers and the population living in the vicinity of gold mines [6].

In the Wanshan mine (China); Children from eating rice that contains methylmercury from these mines are more exposed to mercury than adults and they have shown damage in the development of their Central Nervous System, another problem is intrauterine exposure because methylmercury passes through the placental barrier and its passage through breastfeeding that leads to a decrease in the IQ and it should be noted and emphasized that this neurotoxicity is irreversible [7]. If we know the population that will benefit, according to the statistical data of the Global Mercury Assessment given in 2013: There are about 10 to 15 million people who extract gold from artisanal mines mainly in Africa, Asia and South America and 3 million women and children [6]. An intervention in an efficient and effective way that produces a positive change in your health is a priority. This state of the art will provide new scopes, to define this association of mercury from mining and cardiovascular disease.

Mercury is a heavy metal and one of the most toxic after lead and arsenic [8]. Mercury has an affinity for sulfhydryl groups of enzymes and antioxidants such as N-acetyl cysteine, α-lipoic acid, glutathione which is the most potent intracellular antioxidant [3]. Mercury induces greater

oxidative stress with mitochondrial dysfunction, increases hydrogen peroxide, depletes mitochondrial glutathione by increasing lipid peroxidation and altering calcium homeostasis; the mercury-selenium complex reduces the amount of selenium that is a precursor antioxidant in the formation of glutathione peroxidase that breaks down hydrogen peroxide [3].

Among the cardiovascular diseases that have been evidenced by mercury exposure, it is myocardial infarction, atherosclerosis, arterial hypertension, coronary heart disease [3]. Several mechanisms have been explained by which mercury determines these cardiovascular diseases, although it is not very elucidated; It increases the oxidation of Low Density Lipoproteins (LDL), destroying phospholipid plasma membrane, outsourcing phosphatidylserine that modifies the mitochondrial membrane and generates apoptosis. Another mechanism is the inactivation of paraoxonase, an antioxidant enzyme related to High Density Lipoproteins (HDL) in cholesterol transport. Mercury activates phospholipase A2 that generates severe inflammation that correlates with coronary artery disease; In addition to inducing the formation of arachidonic acid metabolites such as prostaglandins, thromboxanes, leukotrienes that mediate more inflammation in the endothelium [3].

The dose response effect of Mercury has been evaluated by dosing blood, hair and toenail samples. In atherosclerosis, methylmercury due to oxidative stress promotes adhesion of molecules and inflammation that increases the thickness of the inner layer of blood vessels such as the carotid artery, a moderate association is evident. The variability in heart rate due to an increase or decrease in sympathetic activity has been strongly related to a greater amount of methylmercury and in the case of Myocardial Infarctions according to the EURAMIC and KIHD studies, this association has been moderate to strong [9].

Another mechanism that tries to explain the role of mercury in arterial hypertension, is the inactivation of Catechol-O-methyltransferase (COMT), which increases epinephrine, norepinephrine and dopamine in serum and urine; in addition to the relationship of mercury toxicity with stroke and carotid atherosclerosis, due to increased platelet aggregation, increased factor VIII, and endothelial dysfunction [10].

Currently in Korea, a study was published in May, 2019, where approximately 7055 inhabitants were evaluated between 2008 and 2011 and information was extracted from 6 Hospitals in these areas; in abandoned mines, about the relationship between the level of mercury in the blood of the inhabitants and arterial hypertension of these inhabitants and a positive and significant correlation was found [11]. Although in July 2018 a meta-analysis was presented where 37 articles were reviewed and it was found that mercury was not related to cardiovascular disease but instead; lead, arsenic, cadmium and copper if they had a relationship with cardiovascular disease [12].

The objective of this State of Art is to define whether or not there is a relationship between mercury and cardiovascular disease, for which I have reviewed the current literature, following the characteristics of the state of the matter for this issue.

Methodology

I proceeded to search for literature of the publications of the last 5 years in electronic database, using Google Scholar and Medline (via PubMed), with the use of keywords such as: Mercury, mining, cardiovascular disease and state of art in the title and In summary, classify the documents found in order of importance and then analyze, synthesize and summarize their content to obtain the essence and purpose of a state of the art, answering the following questions: How much has been investigated? Who has investigated?, What gaps exist, What achievements have been achieved ?, From what dimensions has it been treated? And what aspects are missing to address? [13].

Results

In the United States, two global policy models were projected based on the Minimata Convention on Mercury and another domestic model: Toxic, air and mercury standards (MATS). This global model action policy as of 2050 according to Minimata has a benefit of $ 1.4 to 575 billion dollars with an average of 339 million dollars, instead the domestic action policy (MATS) has a profit range of $ 6 million to 171 billion dollars in both humans and the ecosystem [5].

History has left us a lot of information about the toxic effect of mercury, such as the death of the Chinese emperor Qin Shi Huang (260-210 BC), who underwent experiments to obtain eternal life. There are many ways in which mercury arrives, by air, water, food, cosmetics, pharmaceuticals, and mining products [3]. Two major disasters due to mercury have been described; one in Japan (Minimata Bay and Agana Rivera) and poisoning in Iraq with methylmercury immersed in a fungicide with devastating economic consequences [3].

There is an important precedent following the publication of the National Council of Researchers in 2011. Regarding the dose- response between mercury and its cardiovascular effects. Where the dosing of mercury was made in different types of samples: Mercury in blood samples in people who consumed fish regularly: in red blood cells, in that to measure organic mercury from dental amalgams and with low exposure to methylmercury and in hair and Toenail on exposed to organic and inorganic mercury with long-term exposure [9].

It was found that myocardial infarction had a moderate to strong relationship with mercury and was based on four studies:

1. (EURAMIC; Guallar et al. 2002); 2. (KIHD; Virtanen et al. 2005); 3.

(HPES; Yashizawa et al. 2002) and 4. (NSHDS; Hallgren et al. 2001).Of these were EURAMIC and KIHD with a positive association with mercury, with significant results, (0.45-0.80) according to RR, OR and 95% CI. Atherosclerosis and decreased heart rate variability had an intermediate relationship with mercury [9].

In Korea, in a period of time from 2008 to 2011. Published in 2019; The relationship between blood mercury concentration and its relationship with arterial hypertension was studied in residents who lived in fields of an old mine, the sample was 7,055 people, a questionnaire was administered and data from 6 hospitals in these areas were reviewed, people with high levels of mercury in blood, were significantly correlated with arterial hypertension than with patients with low levels. The first with Odds Ratio (OR): 1,277; 95% (CI): 1,135-1,436 [11].

Chowdhury et al. In his meta-analysis, I perform a systematic review, where I identify 37 studies; which included the relationship between arsenic, lead, cadmium, mercury and copper with cardiovascular disease. There were 348,259 participants; with 13033 coronary heart disease; cardiovascular accident 4205 and 15274 with cardiovascular disease [12].

The Relative Risk (RR) of arsenic and lead was 1.3 and 1.4 for cardiovascular disease; 1.23 and 1.85 for coronary heart disease and 1.15 and 1.63 for stroke. The RR for cadmium and copper was 1.33 and 1.81 for cardiovascular disease; 1.29 and 2.22 for coronary heart disease, plus 1.72 and 1.29 for stroke. Mercury had no association with cardiovascular disease [12].

The mechanisms by which this affectation is produced by the other components that have an association are not well elucidated but: arsenic accelerates and exacerbates apolipoprotein-mediated atherosclerosis in mice, produces reactive oxygen species in endothelial cells, generates inflammation or high blood pressure. Lead has two pathways, one, accelerates systolic pressure, damages renal function and the other is atherosclerosis, induces oxidative stress, inflammation and

inflammation. Copper is a natural part of essential trace elements for humans but in an excessive way it induces oxidative stress, through the copper-homocysteine complex it produces endothelial dysfunction and vascular injury. Cadmium generates oxidative stress, inflammation, endothelial damage that results in atherosclerosis [12].

Analysis of Results

The latest studies to determine the association between mercury with cardiovascular disease, discussed as background, are old; however, they are part of the review carried out by the Chowdhury et al. Melanalysis already described, which has allowed us to define in this state of the art; This relationship between mercury and cardiovascular disease, whose approach, leads to greater benefit in these most vulnerable populations, with the installation of global policies based on the Minimata Convention in October 2013, in such countries, where the incidence and prevalence is highest of mercury toxicity and decrease morbidity and mortality due to neurotoxicity and decrease of the IQ that is its most recognized association.

There are several confusing factors, in the studies reviewed, one of them is the risk-benefit of fish consumption, because they contain: omega 3, polyunsaturated fatty acids and selenium. In addition, the toxic effect of methylmercury [3].

It would be good to analyze in later studies whether the decrease in methylmercury exposure and quantification of cases of cardiovascular disease; also dose-response of methylmercury with fatal or non-fatal myocardial infarction: make the conversion, in the type of sample where mercury is dosed, which corresponds to 2.44 ug Hg/g hair per ug Hg/g of toenail, to standardize the results [9].

There are several studies that have followed populations for long periods and in this long-term exposure it would have been ideal to make repeated measurements and see individual variations; another point to consider, are the roads or routes: The Environment and the occupation, all adjusted to other confusing factors such as smoking. Also reduce the heterogeneity of the meta-analysis results of different study populations [12].

Conclusion

Mercury is a toxic heavy metal, from mining activity and in its organic form, methylmercury is an important cause of neurotoxicity and decreased IQ but also has no relation to cardiovascular disease.

Conflict of Interest

In this article, the author declares that he has no conflicts of interest.

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