Toxicological Effects of Dioxins in Latin America, a Critical Review

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Introduction

Dioxins are chemical compounds. They are not synthesized by humans but may appear as residues produced by various chemical processes. Dioxins originate naturally in volcanic emissions and forest embers, but unfortunately the main focus of concern is found in human actions such as civil waste cremation, fungicide production, insecticide production, high temperature alloy processing, polyvinyl chloride production, and others (Montoya, 2001).

Human exposure to these substances can take the following routes: digestion, aspiration and contact. Aspiration and contact are the most prevalent, however, it is considered that the main source of exposure is through food consumption. Therefore, it is considered that about 90% of the dioxin uptake comes from food sources, originally from the digestion of milk, red and white meat, eggs, as well as packaging used to cover food (Pinzón Rojas, 2010).

Dioxins belong to a group of aromatic hydrocarbons consisting of two benzene rings bound by two oxygen atoms. They have the following properties: they persist in the atmosphere, soil and water for long periods of time and are therefore highly stable, so they are not prone to chemical or physical degradation, and since they do not come from nature, humans have not been able to develop procedures to decompose them (Luengo, 2008). Therefore, there is currently great social and academic concern, so that in 1994 a study was published on the dangers in our environment due to the exposure of dioxins, in which it is stated that this substance can cause cancer, alterations in development, depression of the immune system and alteration of the normal glandular function (Sánchez & Santi Maldonado, 2021).

The harmful effect of these mixtures depends on the dose and the period of exposure. This occurs by causing changes in the neural, immune and reproductive centers. Living beings are in contact with these substances through oral consumption, aspiration and skin contact, whereby oral digestion is the main way in which dioxins enter organisms, especially through fatty foodstuffs (Núñez Ramos, 2020).

Because of the latter, the research to be carried out will focus on the influence of dioxins on human beings, the perspective to be taken will be the different stages of development and the degree of influence of this chemical on development and growth.

Methods

An analysis of the state-of-the-art was carried out, for which the database was chosen to contain a wide variety of scientific research works, for this reason the Google Scholar, SciELO and ScienceDirect platforms were used.

Subsequently, articles used would be those that were published from 2018 to the present year, since the aim is to have the most updated information, and with data and information related to the Latin America countries. Figure 1 shows most of the articles found from 2020 to 2022

Figure 1 Distribution of articles according to their year of publication

2018-2019 2020-2022

An analysis of the data present in the articles was carried out and it was deci-

ded that data from five countries would be used, namely Mexico, Colombia,



Ecuador, Chile and Brazil, as these had the widest range of data available for this

study. Figure 2 shows the location of the countries selected for the work.

Figure 2

Selection of the countries where the work was carried out and the number of articles found per country



Results

In the nerve center, exposure to dioxins can alter brain function and intellectual development, thus having detrimental consequences on learning. In addition, these compounds can have dangerous consequences on the kidneys, liver and various fundamental organs of the body (Departament de Salut Agència Catalana de Seguretat Alimentària, 2022).

In terms of ailments, it has been linked with great danger to cancer, specifically breast, prostate and non-Hodgkin's lymphoma. It has also been related with heart-related ailments and metabolic irregularities such as type 2 diabetes (García Collado *et al.*, 2022).

Table 1 classifies the exposure to dioxins depending on the country in Latin America and at which stage the highest dioxin influences occur.

Table 1

Age comparison and health effects in Latin American countries

Country	Stages	Illnesses
Mexico	Children Youth Adults Older adults	Mental degrowth and violence (Santander-Lara et al., 2018) Anticipation in adolescence, neurodevelopmental and behavioral disturbance (Yehia Anwar Elsayed, 2019) Heart disease, liver damage (Berumen-Rodríguez et al., 2020) Increases in mortality and cancer (Wolman, 2022)
Colombia	Children Youth Adults Older adults	Irregular development, delayed neural progress. Respiratory diseases such as asthma, bronchitis, menstrual abnormalities, etc. Damage to the pituitary, hypothalamus and damage to the female reproductive system. COPD, lung cancer (Zona Rubio et al., 2022)
Chile	Children Youth Adults Older adults	Genetic variations Cellular changes, cancer in the female reproductive system Fetal anomalies Cancer (Tchernitchin, 2020)
Ecuador	Children Youth Adults Older adults	Liver and breast cancer (Villa Verdugo, 2022) Trauma to the dermis, deformation of the liver Nervous, endocrine and reproductive system disorders Cancer (Quiroz Londoño, 2019)
Brazil	Children Youth Adults Older adults	Mutations of the genitourinary system (Arrizabalaga, 2021) Acute poisoning Cardiac diseases Neural mishaps (García & Zavatti, 2022)

Figure 3 shows that the group most affected by dioxins is adults, followed by the elderly, because when human beings are exposed to this toxin, the highest rates of chronic illnesses occur at this age, since this toxin begins to cause long-term damage during development.

Figure 3

Effects on each age group



In Latin America, these substances have become a significant environmental problem, particularly in countries that are involved in arms disputes or have been the focus of disinfection with fungicides such as Orange Agent. High levels of dioxins have also been found in areas with proximity to chlorine industries and urban areas with high concentrations of vehicular traffic. Exposure to these compounds has severe toxic consequences on human health, including endocrine, immune, reproductive and cancer deficits, as well as consequences on fetal development and brain damage. In certain communities historically exposed to these substances, there have been high rates of lung, breast, and prostate cancer, as well as fertility difficulties, miscarriages and congenital deformities.

Discussion

Although dioxins are globally harmful, their effect within the five selected countries differs, primarily due to the industrial development of the country concerned, as seen by examining the effects of these substances on the citizens of Mexico and Ecuador.

In Mexico City in 2021, an increase in air pollution was recognized, which was caused by the cremation of bodies that were affected by the first wave of Covid-19[19], while this year there were effects on the nervous system of the citizens of Santa Elena parish in Ecuador caused by the presence of the landfill located near the community. (Palma-Morales *et al.*, 2021).

In Chile and Colombia, it was detected that the greatest influence and effect of dioxins on human beings is the product of the release of gases that occur in the manufacture of any type of product, which is why in the first country mentioned two lawyers belonging to the University of Chile published a paper in which they indicate the need to evaluate the sentences for industrial causes that affect the environment (Quijano Echarte, 2019). Similarly, a publication by the Colombian Association of Endocrinology, Diabetes and Metabolism describes how exposure to dioxins causes an imbalance in the metabolism, thus corroborating the need for a better projection of laws against the release of these toxins (Vicente-Herrero & Ramírez Íñiguez, 2022).

Conclusions

It can be recognized that within the greater influence of dioxins found in Latin America, dioxins are more present in the atmosphere due to the presence of the release of gases produced within the companies. This research helped us to conclude that social status, gender and age have a strong influence on the likelihood of suffering from dioxin-related illnesses.

When relating the information from the five countries, it was identified that the female gender may be the one that reports more ailments from these toxic substances and to a greater extent if they are between 45-55 years of age, since in this period they may be more prone to contracting cancer in the reproductive system, as these compounds are found in our bodies and when women who were exposed to them can transmit dioxins to their children through their mother's milk. In the same way, as far as age groups are concerned, the greatest effects can be seen in children and the elderly, as the first group is in its years of development and it is easier for the nervous system to be altered, while the second group, as it has already developed over the years, the system does not have the same defenses and therefore are more susceptible to the damage caused by these toxins.

Therefore, we call on the authorities of Latin American countries to pay more attention to their laws, to seek the safety of all citizens, not only of a certain group. It is essential to have regulations for the companies that generate dioxins and all those that harm health and the environment. In the same way, we as scientists must commit ourselves to always use our knowledge for the benefit of the citizens.

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