



**Saturnism: effects of lead poisoning in humans**

*Saturnismo: efectos del envenenamiento por plomo en humanos*

*Saturnismo: efeitos da intoxicação pelo chumbo em seres humanos*

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**Abstract**

The aim was to describe about lead poisoning and the biological effects of lead in humans. This is a bibliographic review research in which national and international scientific publications were used in the period 2016 and 2022 indexed in the LILACS, SciELO, Books databases, using the keywords Lead Poisoning, worker's health, Biological effects. Lead poisoning can be acquired through the respiratory or digestive tract. In workers it can cause occupational disease. In Brazil, there may be a need to adjust the limits of biological tolerance (LTB), as there are still workers affected by saturnism. In this research, the answer was found that sought preventive measures such as the proper use of PPE, in which they collaborate to improve the health of the population.

**Descriptors:** Lead Poisoning; Safety Management; Occupational Health; Nursing Assessment; Working Environment.

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## Resumén

El objetivo fue describir sobre el envenenamiento por plomo y los efectos biológicos del plomo en humanos. Se trata de una investigación de revisión bibliográfica en la que se utilizaron publicaciones científicas nacionales e internacionales del período 2016 y 2022 indexadas en las bases de datos LILACS, SciELO, Books, utilizando las palabras clave Envenenamiento por plomo, Salud del trabajador, Efectos biológicos. El envenenamiento por plomo se puede adquirir a través del tracto respiratorio o digestivo. En los trabajadores puede causar enfermedad profesional. En Brasil, puede existir la necesidad de ajustar los límites de tolerancia biológica (LTB), ya que todavía hay trabajadores afectados por el saturnismo. En esta investigación se encontró la respuesta que buscaba medidas preventivas como el uso adecuado de los EPP, en los cuales colaboran para mejorar la salud de la población.

**Descriptor:** Intoxicación por Plomo; Administración de la Seguridad; Salud Laboral; Evaluación en Enfermería; Ambiente de Trabajo.

## Resumo

Objetivou-se descrever sobre a Intoxicação por chumbo sendo os efeitos biológicos do chumbo em seres humanos. Trata-se de uma pesquisa de revisão bibliográfica na qual foi utilizado publicações científicas nacionais e internacionais no período de 2016 e 2022 indexados nas bases de dados LILACS, SciELO, Livros, utilizando as palavras-chave Intoxicação por Chumbo, saúde do trabalhador, efeitos Biológicos. A intoxicação por chumbo pode ser adquirida por via respiratória ou digestiva. Em trabalhadores pode causar doença ocupacional. No Brasil, talvez haja necessidade de se adequar os limites de tolerância biológica (LTB), pois ainda existem trabalhadores acometidos por saturnismo. Nesta pesquisa foi encontrado a resposta que buscava medidas preventivas como uso adequado de EPIs, nos quais colaboram para a melhoria da saúde da população.

**Descriptor:** Intoxicação por Chumbo; Gestão da Segurança; Saúde do Trabalhador; Avaliação em Enfermagem; Ambiente de Trabalho.

## Introduction

For more than 4,000 years, lead has been used and it can cause intoxication when this use reaches limits above the tolerated. Saturnism is also the name given to lead poisoning. From the 18th century onwards there was greater attention to lead, as it began to be incorporated into industries. It is currently used in the manufacture of brass, solders, batteries, bronze, dyes, cables, ceramics, ammunition, paints, among others.

Many workers were exposed to lead in the face of this change in industries. Saturnism, in Brazil, was detected by workers and workers with industrialization, and the initial publications appeared in the 1980s, but cases of hematopoietic, renal, reproductive, endocrine, and gastrointestinal intoxication began to be recurrent in workers in factories and industries from the country<sup>1,2</sup>.

This topic is still little addressed in the academic field, this study brings knowledge about the subject of saturnism and reports the effects it brings to the human body caused by lead poisoning. Biochemical alterations are caused by lead, with sideroblastic anemia being one of the possible alterations. Developed by exposure to heavy metal, it alters the functioning of the iron element in red blood cells, making it impossible to carry oxygen in the hematosis process<sup>3</sup>.

According to historical accounts, it caused sterility. Van Gogh and Portinari were victims of lead poisoning. When Van Gogh consumed alcoholic beverages, even in small doses, he displayed aggressive behavior<sup>4</sup>.

Contamination of the organism by lead is subject to the physicochemical properties of the compound, the exposure time and working conditions such as ventilation, concentration in the environment, humidity, physical effort, presence of vapors<sup>5</sup>.

The highest level of lead in the blood is 40 µg/dL and the Maximum Allowed Biological Index (MIBP) is 60 µg/dL. There is an indication of excess exposure when this value is exceeded by the worker, with great chances of risk to health. The American Conference of Government Industrial Hygienists in the United States declares a maximum biological exposure index of 30 µg/dL<sup>4,5</sup>.

The United Nations (UN) in Nigeria has developed some actions to prevent contamination in water sources, which are easily contaminated by heavy metals. Currently, it is imperative to give more importance to lead exposure in developing countries. There is a need to adapt biological tolerance limits (LTB) in Brazil to improve the criteria for Professional Intoxication by Lead-IPCh<sup>6</sup>.

Health professionals can contribute by alerting the population, carrying out surveillance and advising on the problems that exposure to lead can cause, thus preventing future cases. Lead compounds manufactured in industries have a maximum degree of insalubrity, described in the manuals of legislation regarding workers' health. The normal values indicated and the biological tolerance limits, regulated by Ordinance No. 12, of June 6, 1980, of the Secretary of Occupational Safety and Medicine are shown here (Chart 1).



Chart 1. Lead limits established. São Paulo, SP, Brazil, 2022

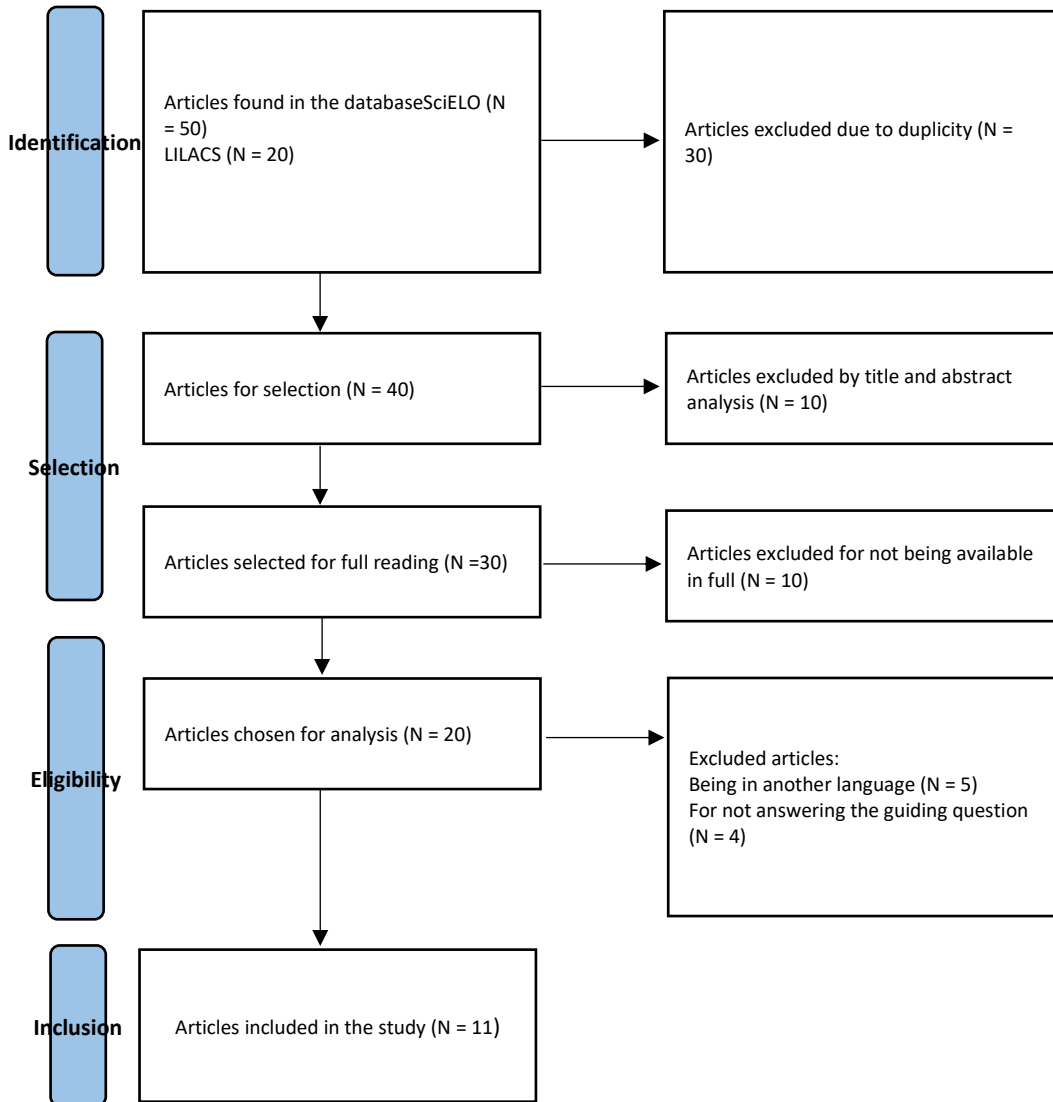
Biological Exposure Index	Normal Value	LTB
Lead in the blood	Up to 40 g/dL	60 g/dL
Lead in urine	Up to 65 g/L	150 g/L
Delta aminolevulinic acid dehydratase	30-60 U/L	10 U/L
Zinc protoporphyrin	Up to 75 g/dL	200 g/dL
Free protoporphyrin	Up to 60 g/dL	300 g/dL
Delta aminolevulinic acid in urine	Up to 4,5 mg/L	15 mg/L

**Methodology**

The method used for this research was through an exploratory study of bibliographic literature review with a qualitative approach, in which information on the chosen topic was researched, thus raising texts published in Portuguese, produced in Brazil, through a database of Scientific Electronic Library Online (SciELO), and Latin American and Caribbean Literature on Health Sciences

(LILACS), selection of texts was carried out through an internet survey, such as academic books, articles and journals relevant to the subject, with a period between 2016 and 2022. The descriptors included in this search were: "Saturnism", "Biological effects of lead" and "Worker's Health". As the author infers today, new challenges are needed to improve scientific dissemination. Below is the flowchart showing the search results.

Flowchart 1. Research layout and selection of articles. São Paulo, SP, Brazil, 2022



**Results and Discussion**

Clinical cases of intoxication are usually more frequent in adult men, directly linking the professional

activity performed, through exposure of metal, in battery manufacturing industries and in an automotive company or other products, such as solders, brass, radiators, bronze,



cables, ceramics, inks and dyes, ammunition and graphics. It is important to emphasize that specialized companies, properly inspected, have appropriate equipment for the individual protection of workers. In women, Saturnism, in addition to occurring in occupational exposure, also occurs

due to hormonal changes and in pregnant women more often, during breastfeeding. This exposure and the consequences of lead poisoning need to be studied on the formation of the fetus and human reproduction. The chart below shows the articles selected for the present study<sup>6,7</sup>.

Chart 1. Distribution of selected publications. São Paulo, SP, Brazil, 2022

Title	Author (s)	Year	Research Type
Avaliação dos níveis de chumbo e mercúrio em população exposta ambientalmente na Região Centro-oeste do Brasil	Jesus et al	2018	Transversal
Case studies in environmental medicine: lead toxicity	Oscar et al	2017	Descriptive
Ciência e multidisciplinaridade	Silva	2021	Descriptive
Current progress on understanding the impact of mercury on human health	Ha, et al	2017	Qualitative
Programa Queimadas - monitoramento dos focos ativos por bioma	Instituto Nacional de Pesquisas Espaciais	2017	Data research
Blood lead levels in a group of children: the potential risk factors and health problems	Mones, et al	2017	Transversal
Avaliação de biomarcadores de exposição, efeito e suscetibilidade para chumbo em indivíduos expostos a resíduos industriais no Condomínio Volta Grande IV, município de Volta Redonda, RJ	Coutinho	2017	Observational, descriptive and sectional
Intoxicações de mercúrio e chumbo com maior prevalência em crianças e trabalhadores no Paraná	Obregón, et al	2021	Descriptive
Regionais de Saúde	Secretaria da Saúde do Estado do Paraná	2017	Data research
Estimativas da População	Instituto Brasileiro de Geografia e Estatística	2017	Data research
Intoxicações de mercúrio e chumbo com maior prevalência em crianças e trabalhadores no Paraná	Adal, et al	2017	Integrative review

Several studies were carried out with workers who worked with lead, they noticed signs and symptoms that are directly associated with the condition of saturnism, such as nausea, Burton's gingival edge and constipation, anorexia, strong intestinal colic, metallic taste, epigastric pain, pallor, insomnia, headache, tremor and weakness<sup>8</sup>.

In 1994, workers with exposure to inorganic lead observed unequivocal evidence of increased reaction time and attention deficit among workers with leademia by the parameter of 40 mg/dl<sup>9</sup>.

A study showed the damage to health caused by lead poisoning at exposure levels that are guided by Brazilian legislation. Some other symptoms reported by the workers mentioned in the report of the two clinical cases are muscle weakness, emotional instability related to sideroblastic anemia, iron accumulation, tiredness, headache, resulting from the defect in the synthesis of hemoglobin chains or defect in the synthesis of protoporphyrin and, therefore, after this deposition leading to the formation of cells presented as sideroblasts, hence the origin of the name sideroblastic anemia<sup>9</sup>.

In cases of intense exposure of short duration, there is a decrease in nerve impulse conduction velocity due to

demyelination and other neurological manifestations that progress in adults to ataxia, hallucinations, exaggerated muscle movements and, finally, to the manic state<sup>10</sup>.

The correlation between these symptoms and the history of occupational exposure is what shapes the diagnosis. Urinary lead excretion should increase markedly, but blood lead concentrations remain close to normal. Treatment of tetraethyl lead poisoning is based on distance from the source of exposure and general measures. In the epiphyses of children's bones it happens, in the radio-dense deposits that interact in the cell membrane, displacing bone calcium, binding to the sulfhydryl radical. Bones are the main reservoir of lead. In the renal system, lead damages the cells of the proximal tubules, resulting in abnormal excretion of glucose, proteins, amino acids and phosphate and interferes with the synthesis of vitamin D, and the urine should have a pink, port wine or burgundy color<sup>10</sup>.

In patients who have chronic renal failure, there is a deficiency in the production of erythropoietin, which causes anemia. Lead levels found in hair strands may reflect exogenous contamination from sources such as darkening agents, dyes, dust from the air in mining or industrial sites, workers exposed to occupational chemicals and people



Voltarelli A, Gatto RS, França CE, Miranda C, Arruda AL, Nascimento AL, Reis NA, Souza MJL materials composed of lead, due to the grandeur of the country and consequently failures in public management. The literature evidences that there is a great abandonment in the professions due to contamination by lead, and for not having knowledge about the disease, professionals do not return, this evidences a gap in knowledge both at the health level and at the inspection bodies.

exposed to environmental pollution.

### Conclusion

In terms of public health, it is essential to avoid lead poisoning, in addition to preventing saturnism through health education and guidance. Inspection in companies is not done on a recurring basis in Brazil, especially when it comes to automotive batteries and other products and

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