Influence of heavy metals on metabolism. Oxidative stress

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INTRODUCTION

Environmental pollution from heavy metals (such as lead, cadmium, mercury, and copper) and other toxic chemical elements poses a serious threat to public health, as these substances enter the environment through dust, smoke, and fumes.

People are exposed to heavy metals via air, water, soil, and food, and the disposal of untreated solid waste is also a risk factor.

Exposure to these toxic elements can lead to severe metabolic disorders, including insulin resistance and other metabolic issues.

METHODS AND MATERIALS

A systematic medical review and meta-analysis were conducted using library databases, including PubMed, Scopus, and Embase. The search covered the period from September 2024 to February 2025, utilizing specific keywords.

Additionally, current national and European legislation, as well as the monitoring of atmospheric air and chemical hazards in the Republic of Bulgaria, were analysed.

RESULTS

The results indicate that the accumulation of heavy metals in the body leads to dysfunction in organs and metabolic processes.

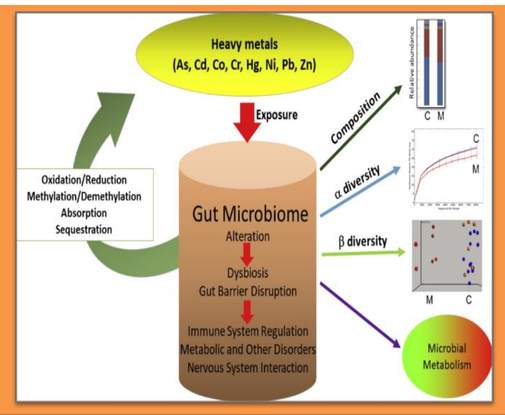
Chronic exposure can cause hepatotoxicity, neurotoxicity, and cardiotoxicity. During their biotransformation in the body, heavy metals interact with enzyme systems and promote the accumulation of free radicals, which disrupt cell functions and trigger oxidative stress. Cells under oxidative stress exhibit various dysfunctions due to the damage caused by free radicals to lipids, proteins, and DNA.

The study also found that certain metals (such as cadmium and iron) reduce insulin production and may induce type 2 diabetes. Individuals exposed to lead (Pb) and mercury (Hg) are at a higher risk of obesity.

DISCUSSION

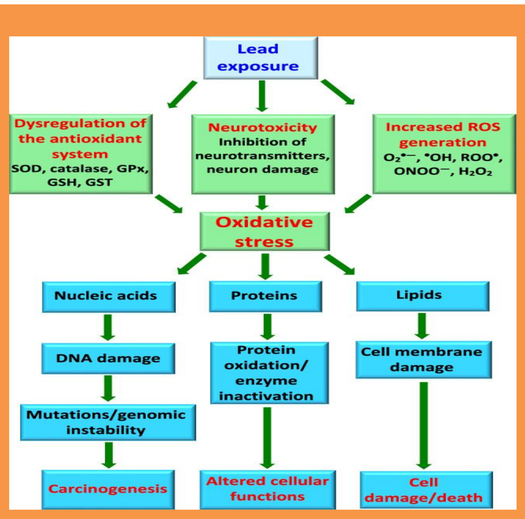
There is increasing evidence in the scientific literature regarding the impact of environmental chemical pollutants and food chemical hazards on human health. Despite the established adverse metabolic effects of heavy metals, the medical community is not objectively assessing potential health risks with the necessary attention, unlike the behavioral risk factors associated with modern lifestyles.

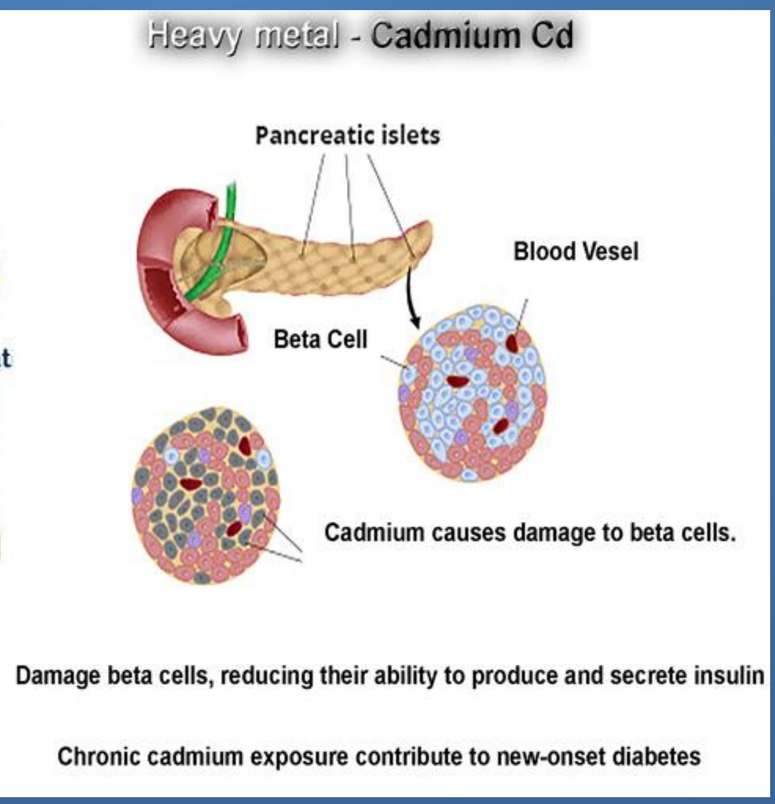
Growing scientific evidence linking heavy metals to metabolic disorders highlights the need for medical professionals to deepen their knowledge of environmental epidemiology and health.



CONCLUSIONS

Preventing exposure to toxic elements in the environment involves hygienic standardization of all potential sources of exposure—air, water, soil, and food. In cases of heavy metal exposure in the workplace and mild intoxication, the implementation of dietary changes, balneotherapy, and temporary work modifications can help reverse the development of metabolic issues.





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