Nutrition as a modifying factor of chemical susceptibility: a systematic evidence map for nervous system health outcomes

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Introduction

That humans vary in response to environmental chemical exposures has long been appreciated. Even in cases of very high pollutant exposure, the range of health effect responses across individuals varies widely, with subsets of the population showing no response and others experiencing chronic disease. There is a critical need to understand both the causes and the magnitude of this differential susceptibility to chemical exposures, particularly considering persistent social and environmental health disparities. One important, yet often overlooked, modifying factor of chemical susceptibility is nutrition.

The purpose of this study was to develop a systematic evidence map to catalog and organize the available literature on how dietary factors may modify chemical susceptibility, focusing on health outcomes related to the central nervous system.

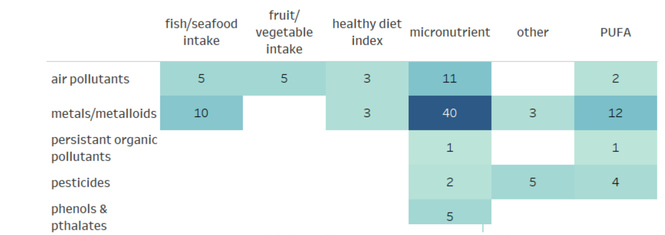
PECO Criteria

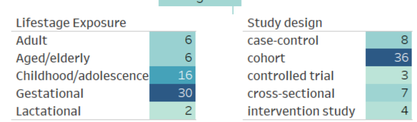
Population (P)
Human study: Any human population.
Animal bioassay: Any *in vivo* system at any life stage.
***In vitro*:** Any *in vitro* model of the nervous system.
Exposure (E)
Exposure to any environmental chemical through any route *and*

- **Human study:** effect modification from any dietary factor
- **Animal bioassay**: co-exposure to any dietary factor via oral route

Comparator (C)
Concurrent control group without dietary co-exposure; comparison or reference population exposed to lower levels of dietary co-exposure.
Outcome (O)
Any health outcome with direct relevance to the central nervous system.

Epidemiologic Studies





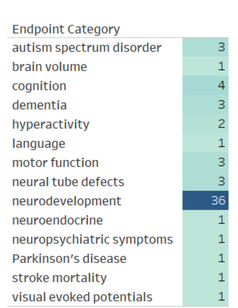


Fig. 1. Heatmaps showing frequency of chemical x diet interactions assessed within epidemiologic studies and frequency of studies by lifestage at exposure, study design, and endpoint categories.

Animal Bioassay Studies

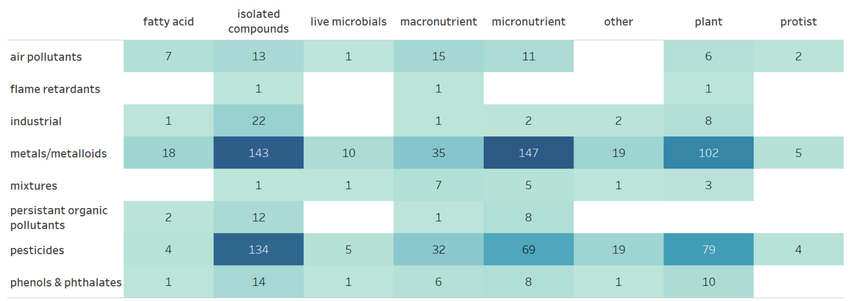


Fig. 2. Heatmap showing frequency of chemical x diet interactions assessed within included animal bioassay studies.

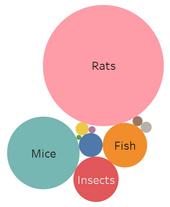
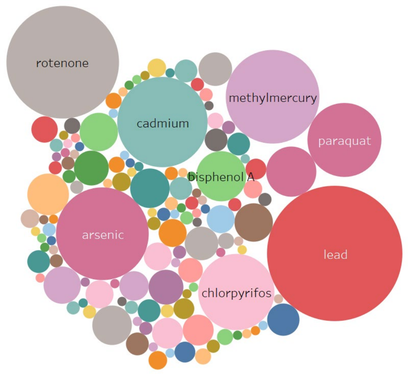


Fig. 3. Bubble plot representing frequency of studied species within included animal bioassay studies.

a) Chemicals



b) Dietary factors

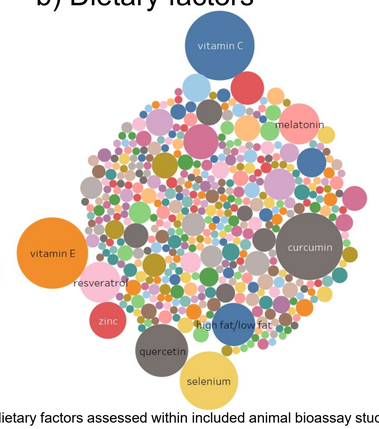


Fig. 4. Bubble plots representing frequency of a) chemicals and b) dietary factors assessed within included animal bioassay studies.

Additional high-level data fields will be extracted using semi-automated methods in Dextr. (10.1016/j.envint.2021.107025)

Fields to include:

- Species & strain
- Sex
- Exposure route
- Treatment groups
- Chemical exposure duration
- Diet/nutrient exposure duration
- Lifestage at exposure
- Lifestage at assessment
- Nervous system endpoints

Literature Search and Screening

Potential references were identified through development of a comprehensive literature search string and then evaluated using a tiered literature screening strategy implemented in DistillerSR. For studies that met our inclusion criteria, the investigated environmental chemical(s) and dietary factor(s) were captured. Additional study design information was extracted from the human epidemiological studies. Extracted data were organized into interactive data visualizations using Tableau.

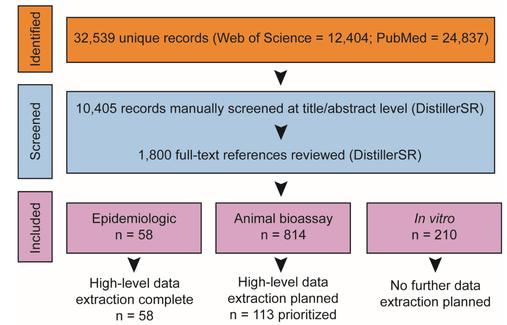


Fig. 5. Literature search and screening flow diagram.

Conclusions

We identified a large dataset of human epidemiologic, animal bioassay, and *in vitro* studies that examined the interaction between dietary factors and environmental chemical exposures on central nervous system health outcomes. This evidence map will facilitate future research into how nutrition modifies chemical susceptibility from environmental exposures. A better understanding of the interactions between nutrition, chemical exposures, and disease risk has the potential to enhance community resiliency and empower overburdened communities.