A Worldwide Review of Studies Examining Toxic Metal Structures Linked to Preeclampsia

Sarah Elizabeth Giang, Rebecca Fry Ph.D.

ENVR 695

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Introduction

- Preeclampsia is medically defined as a maternal body's vascular reaction to placental implantation
- The maternal body can develop hypertension or other symptoms in response to the fetus as a foreign body.
- There is substantial evidence uncovered that long term exposure to toxic metals may lead to preeclamptic symptoms.
- Populational exposure can occur through consuming tainted foods or water and can build up in a maternal body.
- This potentially exposes the fetus to the toxic bodily build up.
- So, to test for toxic metal concentrations, samples of urine, blood, plasma, and placental tissue can be analyzed in a laboratory.
- The objective of the overall review was to analyze previously gathered raw biosample data detailing links between toxic metal exposure and preeclamptic symptoms.
- Additionally, the review investigates types of metals found with the strongest connection to preeclampsia

Discussion and Conclusion

- 2 of the 33 different toxic metals mentioned in the 17 criterion-met studies exhibited noticeable concentrations within preeclamptic patients. Lead and cadmium (**Table 3)** are the most tested for metals across the studies and are also the two most strongly linked to preeclampsia (**Figure 2**)**.**
- 5 of the studies focused solely on maternal blood lead levels, showing already a significant interest into that correlation.
- The ATSDR denotes that there is no safe blood level of lead, but **5.0 µg/dL** and above is an unsafe level.
- In **Table 3**, you can see **6.66 µg/dL, 4.388 µg/dL, 3.36 µg/dL**. Only one of those numbers is above 5.0 µg/dL.
- Cadmium blood levels of **0.2 µg/dL or less**, are safe numbers, but levels above that are toxic and should be treated.
- The calculated average blood cadmium level from North America specifically, where cadmium is the leading linked metal, is **1.525 µg/L or 0.1525 µg/dL** (**Table 3**).
- Analyses of the seventeen criterion-met studies shows that the association between preeclampsia and toxic metals lead and cadmium, are the dominant links (**Figure 2**).
- This conclusion prompts further investigation and research into the specific threshold of bodily concentration of lead and cadmium that correlate with preeclampsia

Methods

- Google Scholar, PubMed and PloSOne were searched for raw data studies published from 1995 to September 31st, 2022.
- Key search terms and text words included: "metals linked to preeclampsia", "preeclampsia worldwide", "preeclampsia", "toxic metals", as well as additional key words detailed in **Table 1**.
- The criterion for selection was settled before the actual search was conducted and is outlined in **Table 2**.
- 17 papers were selected from a pool of biosample data studies, specifically researching toxic metal linkages to preeclampsia.
- An emphasis was put on choosing a wide range of locations from across the globe, however the search into criterion-met studies in South America and Oceania yielded no results.
- After compiling a list of articles from the database search, articles were then measured against the criterion in **Table 2**. A study must meet all Acceptable Criterion to be accepted into this review. Additionally, if an article was unclear in any manner, it was measured under Unacceptable Criterion and not included in any further study.

Figures

Table 1

Databases:	Google Scholar, PubMed, PlosOne
Time Frame:	September 1st, 2022 to September 31st, 2022
Keywords:	**Related Searches:**
Preeclampsia	Preeclampsia during pregnancy, postpartum preeclampsia, preeclampsia linked to metals, environmental links to preeclampsia
Metals	Metal structures, elements, toxic elements, toxic metal structures, natural metals
Hypertension	Hypertensive disorders, pregnancy hypertension, hypertension linked to metals, hypertension linked to environment, hypertension linked to toxic metals
Toxic	Toxic metals linked to preeclampsia, toxic environmental metals

Figure 1

Figure 2

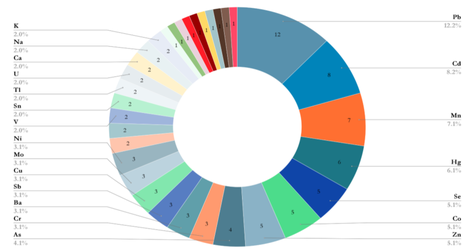

Table 2

Acceptable Criterion	Unacceptable Criterion
Location of study explicitly detailed	Location is not detailed or is unclear
Included clear statement of toxic metal structures tested for	Toxic metal structures not explicitly revealed or is unclear
Testing cohort demographic includes human preeclamptic subjects as well as human control subjects	Testing cohort demographic includes only preeclamptic subjects, cohort is not human, or cohort demographic is unclear
Biosample testing done on blood, plasma, urine, or placental tissue	No biosample testing occurred or testing methods are unclear
A clear conclusion was made or study findings warrant further investigation	No clear conclusion was made or study findings found no significant results or study findings are unclear

Table 3

Continent:	North America
Average number of individuals in a cohort:	994.6 individuals
Percentage(s) of biosamples taken:	40% blood, 20% plasma, 20% urine, and 20% placental tissue
Strongest linkage of a metal to preeclampsia:	Cadmium (Cd)
Average concentration of exposure (per biosample) to strongest linked metal:	Blood - 1.525 µg/L Plasma - N/A Urine - N/A Placental Tissue - 3.6 ng/g

Continent:	Europe
Average number of individuals in a cohort:	93 individuals
Percentage(s) of biosamples taken:	50% blood, 50% placental tissue
Strongest linkage of a metal to preeclampsia:	Lead (Pb)
Average concentration of exposure (per biosample) to strongest linked metal:	Blood - 3.36 µg/dL Placental Tissue - 0.03 $\mu g/g^{-1}$

Continent:	Asia
Average number of individuals in a cohort:	480.6 individuals
Percentage(s) of biosamples taken:	87.5% blood and 12.5% placental tissue
Strongest linkage of a metal to preeclampsia:	Lead (Pb)
Average concentration of exposure (per biosample) to strongest linked metal:	Blood - 4.388 µg/dL Placental Tissue - N/A

Continent:	Africa
Average number of individuals in a cohort:	126.5 individuals
Percentage(s) of biosamples taken:	66.6% urine and 33.3% blood
Strongest linkage of a metal to preeclampsia:	Lead (Pb)
Average concentration of exposure (per biosample) to strongest linked metal:	Blood - 6.66 µg/dL Urine - 32.315 µg/L

Main Findings

- The locations of the final seventeen criterion-met studies are shown in **Figure 1**.
- The final list of metals specifically tested for in all 17 studies, in alphabetical order, are: aluminum (Al), antimony (Sb), arsenic, (As), barium (Ba), beryllium (Be), bismuth (Bi), cadmium (Cd), calcium (Ca), cesium (Cs), chromium (Cr), cobalt (Co), copper (Cu), indium (In), iron (Fe), lead (Pb), lithium (Li), magnesium (Mg), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), phosphorous (P), platinum (Pt), potassium (K), selenium (Se), sodium (Na), strontium (Sr), tellurium (Te), thallium (Tl), tin (Sn), tungsten (W), uranium (U), vanadium (V), and zinc (Zn).
- **Figure 2** is a breakdown of the number of times each metal is tested for in the seventeen criterion-met papers.
- **Table 3** contains all other relevant information pulled from the criterion-met articles

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Many thanks to Gillings SPH and Rebecca Fry, Ph.D.,

Director of the Institute for Environmental Health Solutions and Distinguished Professor in the Department of Environmental Sciences and Engineering in the Gillings School of Public Health at UNC-Chapel Hill