Smoking behavior and heavy metal exposure in women affected by the Deep Water Horizon Oil Spill

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Abstract
Cadmium is a highly toxic naturally occurring element that can be found in air, soil, water, and plants. Cotinine is a nicotine metabolite that can be quantified and related to exposure to Environmental Tobacco Smoke (ETS). The average blood cadmium for women of child-bearing age in New Orleans as well as the salivary cotinine concentration in two groups of women, those who reported exposure to ETS, and those who reported no exposure to ETS were analyzed. Our findings indicate that the average blood cadmium level of women in New Orleans is higher than the national average. This study found that the average blood cadmium level of women in New Orleans is 0.62 ug/L while the national average is 0.38 ug/L. This study also found the average salivary cotinine level in women of child-bearing age who reported no exposure is 4.937 ng/mL. The average for women who reported exposure to ETS is 87.62 ng/mL. Results also indicate that salivary cotinine levels are directly correlated to blood cadmium levels with a significance of 0.001. These results are in keeping with current literature. Directions for future research includes investigating the possible causes for elevated blood cadmium concentration levels and a possible correlation between salivary cotinine concentration, blood cadmium levels, and reported exposure to ETS.

Methods & Materials
Method #1: Self-Reported Smoking data:
- Self-reported smoking was drawn from two different surveys from G.R.O.W.H. (Gulf Resilience on Women’s Health) Consortium, Project #1.
- Questions pertaining self-smoking and in-home smoking behavior were analyzed.

Method #2: Salivary Cotinine Assay
- Material:
  - 96-well ELISA plate
  - Cotinine standard: 0.5 mL of cotinine in a saliva-like matrix with a non-mercury preservative
  - Wash Buffer: 10 X phosphate buffered solution containing detergents
  - Assay diluent
  - Enzyme conjugate: (horseradish peroxidase)
  - Tetramethylbenzidine (TMB): (light sensitive)
  - Stop solution: 2M sulfuric acid
  - Cotinine controls (high concentration, Low concentration)
- Procedure:
  - Saliva samples were taken from multiple pregnant and non-pregnant women across the city.
  - This assay was done using a 96-well ELISA plate.
  - The samples were taken by G.R.O.W.H. and were frozen in our lab until the samples were ready to be tested.
  - The assay used was the Salimetrics salivary cotinine quantitative enzyme immunoassay.
  - Samples were analyzed using Tecan’s infinite NanoQuant spectrophotometer, and were coupled with Magellan data analysis software.

Method #3: Determination of Blood Cadmium levels
- Blood samples were taken from participants in G.R.O.W.H. studies.
- Samples were acidified with NH3 (Nitril acid)
- Samples were then shipped to Robert J. Taylor (Trace Element Research Laboratory) at the College of Veterinary Medicine at Texas A&M University
- Samples were then analyzed using a ICP-MS to determine Cadmium in ug/L.

Results
The average cadmium level amongst women of reproductive age in the city of New Orleans is 0.62 ug/L (95%CI 0.67-0.67). ATSDR reported that the national geometric mean of cadmium levels was 0.38 ug/L in 2012. This is less than the NHANES survey from years 1999-2004 which reported that national average as 0.44 ug/L. The average cotinine levels for women unexposed ETS is 4.937 ng/mL and the average cotinine levels for exposed ETS is 87.62 ng/mL. Results also indicate that salivary cotinine levels are directly correlated to blood cadmium levels with a significance of 0.001.

Conclusion
- This study found that women of child-bearing age exposed to ETS have higher salivary cotinine levels than those unexposed to ETS. Women of child-bearing age in New Orleans, Louisiana have higher blood cadmium levels than the national average. A report by the ATSDR sets the national average at 0.38 ug/L. In this study, the average for women of child-bearing age for blood cadmium is 0.62 ug/mL. This is significantly higher than the national and state reported averages.
- Additional limitations include lack of salivary samples for the group of pregnant women, and lack of data for population comparison for blood cadmium levels, and salivary cotinine levels for cities that have a population similar to New Orleans, cities such as Jackson, Mississippi, Boston Massachusetts, and Baton Rouge, Louisiana.

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