CONGENITAL HEART DISEASE AND THE EMISSION OF DEVELOPMENTAL TOXICANTS IN ALBERTA, CANADA

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BACKGROUND

- Congenital heart disease (CHD) is a significant global public health issue affecting 1% of all live births and the most common lethal congenital abnormality in infancy[1]
- The aetiology of CHD in most affected infants and children remains unclear
- Preliminary reports have suggested a potential relationship between specific chemicals and urban pollution and CHD, but these reports have demonstrated inconsistent findings using varied methodologies and largely focus on single chemicals[2-4]
- In our preliminary work, we had demonstrated strong positive correlations between rates of CHD and several organic compounds and negative correlations with metals released from industries in Alberta[5]
- In this present study, we sought to explore the association between mixtures of developmental toxicants (DTs) released from industrial sources and rates of CHD in Alberta, Canada

HYPOTHESIS

There is an association between rates of CHD and mixtures of developmental toxicants released by industry in Alberta, Canada

OBJECTIVE

1. To apply the Principal Component Analysis method (PCA) to determine the groupings of the mixtures of the DTs
2. To determine if there is non spatial correlation between rates of CHD and component groupings of mixtures of DTs

METHODS

Study Design: Analytic Ecologic Study

Industrial Pollutants:

Accessed Alberta's National Pollutant Release Inventory (NPRI) for the years 2003-2010

- Identified 17 developmental toxicants (DTs) out of 366 reported chemicals released from over 3600 facilities in Alberta. A DT is an agent that causes adverse effects on the fetus and biological dysfunction of the developing child
- We calculated the risk score for each DT by multiplying the mass of the chemical with its toxic equivalent potential (TEP) obtained from Scorecard

Statistical Method:

The selected 17 DTs were subjected to multivariate PCA analysis as follows:

- Factor analysis was undertaken to determine factor loadings for each DT. All DTs with a factor loading value of ≥ |0.60| were included in the matrix
- PCA was performed and components with an Eigenvalue >1 were selected
- Three components were chosen and these accounted for 85% of cumulative variability
- Predictive scores of the components were calculated using post estimation
- Correlation analysis between component predictive scores and rates of CHD was conducted

Statistical Analysis:

- Multivariate PCA and linear regression using STATA 12

RESULTS

Component 1 (n = 13) r = 0.94, p < 0.01	*FLV
Benzene	0.63
1.3 Butadiene	0.90
Carbon Disulfide	0.84
Chloroform	0.72
Ethylene Oxide	0.96
Hexachlorobenzene	0.95
Tetrachloroethane	0.85
Methanol	0.68
Mercury	0.77
Sulphur Dioxide	0.96
Cadmium	-0.96
Lead	-0.97
Toluene	-0.84

Component 2 (n = 2) r = 0.06, p = 0.87	*FLV
Tetrachloroethylene	0.79
Trichloroethylene	-0.88

Component 3 (n = 2) r = - 0.09, p = 0.82	*FLV
Arsenic	0.79
Carbon Monoxide	-0.69

Components 2-3: No statistical significance.

Table 1 Principal Component Analysis Matrix. *FLV = Factor Loading Value

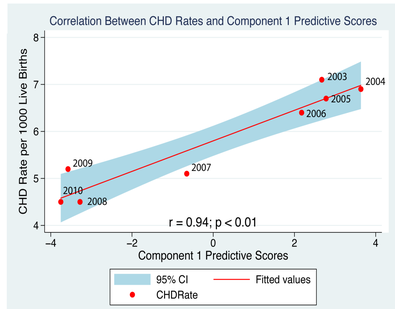

Figure 1 Correlation Between CHD Rates and Component 1 Matrix

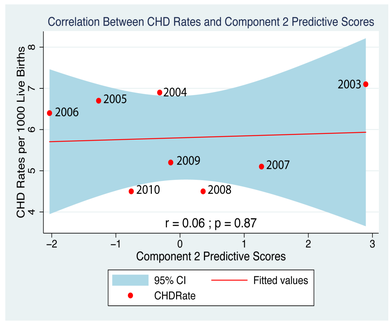

Figure 2 Correlation Between CHD Rates and Component 2 Matrix

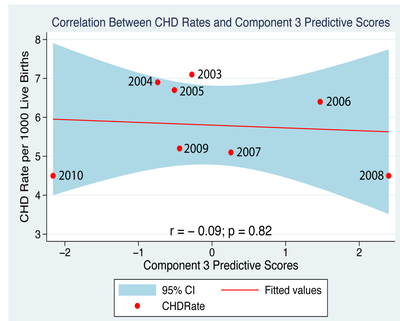

Figure 3 Correlation Between CHD Rates and Component 3 Matrix

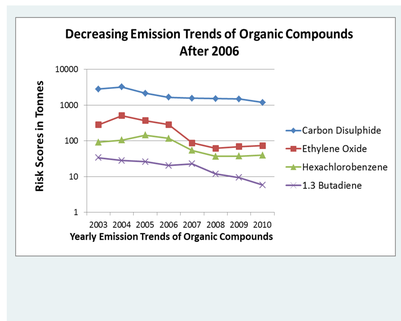

Figure 4 Emission Trends of Organic Compounds After 2006

CONCLUSIONS & FUTURE DIRECTIONS

- Component 1 which consisted of a mixture of organic compounds and metals, was positively strongly correlated with rates of CHD
- A clear pattern was observed after 2006 in which decreasing rates of CHD corresponded with lower predictive scores of component 1
- Preliminary analysis of the DTs trends after 2006, revealed decreased emissions of the organic compounds
- Our future directions include exploration of the impact of an industrial sector shift on the rates of CHD brought about in Alberta in 2006 and the use of Geographic Information Systems (GIS) to investigate spatial correlations of CHD rates and DTs in Alberta

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