

MULTIPLE METAL EXPOSURES IN ADOLESCENTS: ATTENTION-INDUCED STRESS, LEAD, ARSENIC AND CARDIAC VARIABILITY

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Background and Aims: Cardiovascular mortality and morbidity in adults increase at lead and arsenic concentrations well below most international occupational guidelines. The few published studies of lead and cardiovascular function in children produced weak and conflicting results. Few studies systematically address multiple metal effects on cardiac health. We studied the combined effects of lead and arsenic on heart rate variability (HRV), a key predictor of cardiovascular morbidity and mortality, in adolescents to determine if metal exposures were associated with early signs of cardiovascular problems.

Methods: We recorded seated electrocardiograms (ECG) from 512 adolescents, 12-15 years, participants in a lead-surveillance program since early childhood in Torreón, Coahuila, a northern Mexican industrial city. We measured blood lead and spot urine creatinine-corrected arsenic on the recording day. We recorded three 10-minute ECGs, first with subjects in resting condition, the second and third during the Continuous Performance Test (CPT), a sustained attention task requiring response to rarely presented target sequences in easy and difficult conditions designed to produce cognitive stress, in counterbalanced order. Fourier decomposition produced power spectra of beat-to-beat ECG intervals. We analyzed CPT performance and ECG power in standard frequency bands with mixed models accounting for repeated measures. We also present models combining earlier childhood lead levels with contemporary arsenic concentrations.

Results: Lead and arsenic independently depressed CPT attention (no significant interaction) with no effect size change under two stress levels. High frequency HRV (0.14-0.40 Hz), indicating parasympathetic autonomic nervous system (vagal) activity, decreased with increasing stress, but paradoxically increased with increasing arsenic concentration in all conditions.

Conclusions: Lead and arsenic additively combined to depress sustained attention in adolescents. Cognitive stress depressed cardiac-vagal tone while arsenic increased vagal tone. We further explore connections between multiple metal exposures, attention and autonomic nervous system activity associated with cardiac health.