THE RELATIONSHIP BETWEEN URINARY METALS CONCENTRATIONS AND OXIDATIVE STRESS IN A COHORT OF SCHOOL AGE CHILDREN

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Keywords: urinary metals; oxidative stress, children, environmental exposures

Introduction

Oxidative stress can be induced by metals via the generation of excessive reactive oxygen species (ROS) and has been implicated in adverse health outcomes (Sughis et al., 2012). Metals are released into the environment from many activities and specifically industry and traffic. Children living in areas with sources of metals are at an increased risk of exposure to metals and hence the potential for the production of ROS. The Kwinana region of Western Australia is an area noted for heavy and light industry, including freight traffic. In 2009 a cross sectional study of children's respiratory health was undertaken in school age children aged between 4 and 12 years of age in the Kwinana region to investigate the potential for industrial emissions to affect children's respiratory health (TICHR et al., 2011). Industrial areas are also known to emit metals which may result in exposure and adverse health effects (Markandya, & Wilkinson, 2007; Cara et al., 2007). These children provided spot urine samples which were analysed for metals concentrations and also for a marker of oxidative stress (8-hydroxy-2-deoxyguanosine (8-OHdG)) to investigate any potential associations.

Methods

We measured 14 urinary metals (Al, Mn, Co, Ni, Cu, Zn, Ga, Sr Cd, U, As, Pb, Cr, Fe) using ICP-MS (Thermo Scientific, Bremmen Germany) in a group of 294 school children aged 4 to 12 years. We measured 8-hydroxy-2-deoxyguanosine (8-OHdG) in urine samples as a marker of oxidative stress using the new 8-OHgD Check ELISA (Japan Institute for the Control of Ageing, Shizouka, Japan). Urinary measures were adjusted for specific gravity which was analysed using a handheld refractometer (Atago Co, Ltd, Tokyo Japan). Urinary metals concentrations were adjusted for specific gravity using the study mean of 1.024gml^{-1}. Descriptive analyses were undertaken using non parametric tests (SPSS version 23).

Results

Median urinary metals concentrations were generally low with some elevated concentrations observed (Table 1). Median OHdG concentrations were 8.1 ng/ml. Significant Spearman rho correlations were observed between 8-OHdG and concentrations of the urinary metals Co (r_s=.264), Cr (r_s=.173), Pb (r_s=.145), Cu (r_s=.348), Zn (r_s=.219) and Cd (r_s=.153).

Table 1. Urinary metals and 8-hydroxy-2-deoxyguanosine concentrations.

	Observed Urinary Concentrations (µg/L) n=294			Specific Gravity Adjusted Concentrations (µg/L) n=281	
Metal	**% <LOD**	**Median**	**Range**	**Median**	**Range**
Al	0	37.3	1.44 - 8740	38.7	1.51 – 9610
Mn	5.1	0.25	<0.05 - 10.8	0.25	0.02 – 19.9
Co	0	0.72	0.03 - 27.0	0.71	0.04 – 42.5
Ni	0	5.88	0.19 - 119	6.21	0.21 – 105
Cu	0	12.7	0.53 - 6290	13.3	0.61 – 5540
Zn	0	387	6.81 - 1710	392	7.14 – 1640
Ga	88.8	<0.02	<0.02 - 1.67	<0.02	<0.02 – 1.83
Sr	0	3.16	3.16 - 530	129	3.31 – 466
Cd	55.8	<0.05	<0.05 - 6.27	<0.05	<0.05 – 7.01
U	81.0	<0.01	<0.01 - 0.41	<0.01	<0.01 – 0.08
As	0	7.72	0.37 – 578	7.79	0.42-754
Pb	0	0.81	0.005 – 6.13	0.93	0.005 – 13.6
Cr	0	0.41	0.022 – 29.1	0.42	0.025 – 28.4
Fe	0	12.73	0.05 – 420	14.4	0.05 – 369

Discussion and Conclusion

This study confirms the findings of others studies where urinary metals concentrations were correlated with 8-OHdG levels (Pizzino et al., 2014). It is interesting to note that both copper and zinc are essential metals and were also increased in the urine of children with increased 8-OHgD levels.

An investigation into the sources and factors that affect metals exposure and oxidative stress in this group is in progress.

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