

In Focus: Air Pollution Effects on DNA

Small Particles Penetrate Right Down To DNA

Commencing several years ago, the New South Wales Governments' Department of Environment and Climate Change (DECC) started publicizing regional pollution index measurements twice daily in addition to providing 24-hour summaries to the public (<http://www.environment.nsw.gov.au/aqms/aqi.htm>). These moves have come in response to increased concern from the public regarding the level of air pollution and its health impacts. As evidence, in a recent survey commissioned by the Department of Environment and Conservation of NSW, responders ranked environment as the third most important part of their lives, below family and friends respectively and above leisure time, work, and service to others. And rightly so too; the detrimental effect of air pollution on an individuals health are now widely recognized by some of the most prestigious researcher centres in public health.³

Particulate Matters

Small or fine particulate matter (PM) is one of the major indexes used in the measurement of air pollution. The size of a particle determines its potential impact on human health; with larger particles usually trapped in the nose and throat, while smaller particles may reach the lungs and cause irritation there. Bioavailable transition metals, such as vanadium that make up PM are said to participate in chemical reactions to produce reactive oxygen species leading to oxidative DNA damage.

8-Hydroxy-2-deoxyguanosine

The most widely studied biomarker of oxidative DNA damage is 8-hydroxy-2-deoxyguanosine (8-OHdG). 8-OHdG is a particular type of reactive oxygen species-induced DNA base modification (i.e., the C8 hydroxylation of deoxyguanosine). 8-OHdG is premutagenic because it can mispair with adenine instead of cytosine during DNA replication, and if this occurs, a G to T transversion mutation develops. The repair mechanism for DNA after 8-OHdG is incorporated into DNA involves base and nucleotide excision with DNA-specific nucleosides excreted into urine.¹ Therefore the measurement of urinary 8-OHdG can be used as an overall estimate of repaired oxidative DNA damage within an individual.²

Heard Of ROFA?

ROFA is a fancy acronym for Residual Oily Fly Ash. ROFA is a component of ambient PM and is typically a chemically complex mixture of compounds that are potentially carcinogenic because of their ability to cause oxidative injury. The chemical composition of ROFA includes sulfates, silicates, carbon- and nitrogen-containing compounds and metals.⁴ ROFA is generated from the combustion of fossil and waste fuel which makes it a major contributor to the ambient air PM burden in Australia.

ROFA Effects On 8-OHdG

To determine just how toxic occupational exposure to ROFA can be, researchers from the Harvard School of Public Health recently investigated the effect of daily exposure on urinary 8-OHdG levels in a group of boilermakers performing maintenance and repairs on oil-fired boilers. After monitoring twenty workers for 5 days during an overhaul of oil-fired boilers, urinary 8-OHdG levels were significantly greater in the post-

workshift samples than in the pre-workshift samples after adjusting for confounding factors. To download the study in full, please click on the following link.

<http://www.pubmedcentral.nih.gov/picrender.fcgi?artid=1241959&blobtype=pdf>

ROFA's Everywhere

In addition to occupational exposure in professions such as boilmaking, asphalt in road pavements produces particulate matter containing ROFA.⁵ Other common exposure sources are diesel exhaust. In fact, anyone living in an industrialized city and regularly using an automobile will have increased PM exposure relative to someone in a non-industrialized city where exposure to exhausts from coal and petroleum are considerably less.

8-OHdG Unique To Organix

The above study is just a sample from a plethora of studies that have explored the link between various measures of air pollution and the oxidative DNA damage biomarker, urinary 8-OHdG. This vast body of literature underlies the increasing importance of measuring the effects of the ever-changing environment on an individuals' health. Metamatrix have recently published the innovative method they have developed for measurement of 8-OHdG in urine samples in the journal *Biomedical Chromatography*.⁷ As such, 8-OHdG is a validated biomarker, unique to Metamatrix. It can be ordered by itself (#0087) or as part of the Organix Comprehensive Profile.

References

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