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Impact of Firecracker Emissions on Heavy Metal and Chemical Levels in Human Urine Samples in Delhi

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Abstract

Introduction: India is a large country with huge diversity in cultures, festivals and social events. Burning of firecrackers during festive season is the culprit of a substantial increase in the particle's pollution in India. During Diwali and winter season, an upward trend of pollutants has been noticed. The major constituents of smog that form from firecracker emissions contain SOx, NOx and significant dust load or particulate matter that may contain the following heavy metals: Pb, Cu, Mg, Sr, Li, Al etc.

Heavy metals have harmful effects on human health like Gastrointestinal and kidney dysfunction, nervous system disorders, skin lesions, vascular damage, immune system dysfunction, birth defects, and cancer. Bioaccumulation of these heavy metals leads to a diversity of toxic effects on a variety of body tissues and organs. Heavy metals disrupt cellular events including growth, proliferation, differentiation, damage-repairing processes, apoptosis and genomic instability.

Methodology: After dividing Delhi into four zones, families of these areas were interviewed by using a specifically designed questionnaire considering the respiratory, skin, ear, eye and other relevant symptoms for three days before Diwali and three days after Diwali along with spirometry. Urine samples of 50 subjects were analysed by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Samples were collected before Diwali and after Diwali from the same subjects for estimation of seven heavy metals.

Results: Comparison of Metal and Chemical Levels in Urine Samples Before and After Diwali Celebration

Lead (150.01 post-Diwali vs 24.52 pre-Diwali), Copper (98.73 vs 24.22) Potassium (86.89 vs 72.94) Aluminium (180.06 vs 96.47) Magnesium (200.49 vs 134.32) Barium (4.49 vs 2.76) and Strontium (147.7 vs 71.59). Chemical estimation from blood samples was also done using ICP-MS for Nitrate(8.92 vs 5.20) ,Sulphur(98.94 vs 37.38), Barium Nitrate(137.88 vs 41.46), Potassium Nitrate(186.04 vs 70.07) and Barium chromate(29.67 vs 1.57).

Post-Diwali urine samples had abnormally high heavy metals in all zones.This abnormal higher concentration of heavy metals led to increased hospitalization due to burns, eye problems, breathing difficulties and even stroke due to deterioration in air quality index following Diwali.

Conclusion: The study revealed that firecracker use during Diwali celebration caused a significant increase in the levels of heavy metals and chemicals in human urine samples in Delhi. These pollutants can have adverse effects on human health and well-being, such as respiratory, skin, ear, eye and cardiovascular problems. The study suggests that there is a need for more awareness and regulation of firecracker use and emissions in Delhi to protect the environment and public health.