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Exploring PM chemical Composition and personal exposure in Auto Repair Garages: A Glimpse into the Grit and Grime of Garage Workers

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Abstract

Introduction: India is a key player in the global automotive industry, contributing over 7% to the national GDP. The auto repair garage (ARG) business is rapidly expanding to meet the growing demand, with 53% of the contribution coming from unorganized ARGs. Auto repair workers, vital to the sector's functioning with tasks like mechanical repairs, bodywork, tire retreading, spray painting, and battery repair, face significant occupational health risks despite their crucial role. A primary background study was conducted to understand the symptoms experienced by ARG workers. From that it was found that Respiratory symptoms (Coughing – 72%, Wheezing – 44%, Shortness of breath - 38%) and Nasal and throat symptoms (stuffy nose – 65%, Sore throat – 53%, Irritation in throat – 35%). This triggered us to conduct this study to understand personal exposure to ARG workers. Our aim is to explore the size fraction of particles they encounter and examine the deposition patterns in different regions, including the head, tracheobronchial, and pulmonary region.

Material and Methods: To perform this the monitoring was carried out at Coimbatore, Tamil Nadu by using a 5-stage cascade impactor to obtain size bins (PM2.5, PM1, PM0.5, PM0.25, and PM<0.25), ICP-MS was performed to decode the elemental composition and SEM to obtain the morphology of the particles for a duration of 25 days. Whereas Multiple path particle dosimetry model was used to obtain the deposition dosage at the various regions in human respiratory tract for the ARG workers.

Results: After rigorous examination, it was discovered that the arithmetic mean of PM as follows: PM<0.25: 201.49 µg m-3> PM2.5: 198.25 µg m-3 > PM1: 143.45 µg m-3> PM0.25: 104.94 µg m-3> PM0.5: 80.17 µg m-3. The elemental composition revealed a significant presence of 21 elements among that Al - 32% > Ba - 27% > Zn - 23% > Fe - 16% > B - 2% showed the major contribution. The morphology showed the presence of thin elongated mineral particles and crystalline particles ranging from 75.3 nm to 578.6 nm from SEM analysis. The maximum deposition of PM2.5 at head (43%) and PM1 at pulmonary region (38%) to the ARG workers of average BMI was observed.

Conclusion: Among these elements identified Zn, Al and Fe have positive association with respiratory irritation, wheezing and shortness of breath. The maximum daily dose for the ARG workers found about Zn - 3.71×10-3 mg/kg/day. The symptoms caused by the exposure to ARG workers have 58% mapping with respiratory related diseases and 43% chronic obstructive pulmonary disease.