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Work-exposure to PM_{10} and VOCs, excretion of urinary VOC metabolites and effect on hematological parameters, genotoxic effects and on the pulmonary function of workers in Kolkata city, India

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The atmospheric air of metropolis is highly complex due to the combined effect of traffic related activity, industrial and commercial activities with high population density. The complexity of air pollutants is mainly due to fine particulates (≤ 2.5μm) containing fossil fuel soot, bio-fuel soot (having black carbon, primary organic matter, sulfate, absorbed organic chemicals, metals etc.) and volatile gases that cause local climate change and adverse health impact. Risks of cardiovascular morbidity and mortality, adverse respiratory outcome, cancers are increasing among city population. Work-exposure to exogenous risk factors like PM_{10}, VOCs, biological monitoring of VOC metabolites in urine were assessed among two occupational groups, petrol pump workers and traffic police within the city. Hematological changes, genotoxic effect and respiratory health of workers were also studied among the exposed groups.

PM_{10} and size distribution within the periphery of petrol pumps and traffic zones were done by 8-stage Cascade Impactor. VOCs in air were estimated by GC, FID and five urinary VOC metabolites, tt-MA, SPMA, HA, MA and MHA were meassured simultaneously by HPLC after SPE. DNA damage in peripheral lymphocytes was assayed by alkaline Comet assay. Pulmonary function tests of a sub set of two occupational groups were done by Spirometer and Wright's Peak Flow meter.

PM_{10} in the range, 176.0-401.2 and 200.0-590.0 μg/m^3 obtained respectively in static air of petrol pumps and traffic zones and the size distribution showed, 49.9% of the PM_{10} in the size range, <9.0 μm-4.7 μm and 26.8%, ≤2.1 μm, in the former and 50.9% of <9.0 μm-4.7 μm and 26.8%, ≤2.1 μm in the later. Mean exposure of petrol pump workers to toluene has been found highest (567.4 ± 21.15 μg/m^3) of all the VOCs and the values were found to be lower compared to the ACGIH, TLVs, as the work-areas are in the open. In case of traffic police personnel, the exposure to benzene was found to be the highest (104.6 ± 99.0). Exposure to benzene was many times higher than the ambient CPCB standard as well as that prescribed by the UK and European Commission.

The pre- and post-shift urinary tt-MA and SPMA were respectively 0.59 & 1.10 mg/g creatinine and 1.58 & 1.70 mg/g creatinine among petrol pump workers. The post-shift urinary HA, MA and MHA in petrol pump workers were respectively, 8.05, 2.62 and 1.61 mg/g creatinine, found higher than pre-shift and so also in traffic police . The air benzene levels around petrol pump correlated significantly with post-shift urinary tt-MA ($p<0.001$) and SPMA ($p<0.001$) and the air toluene, ethylbenzene and xylenes, correlated significantly ($p<0.001$) with pre- and post-shift urinary HA, MA and MHA respectively. The post-shift metabolites of traffic police found significantly higher than the pre-shift in case of tt-MA ($p<0.05$), HA ($p<0.05$) in terms of mg/gcreatinine. Post-shift urine metabolite values were significantly higher than that of the non-occupationally exposed population ($p<0.01$). A decreasing order of urinary biomarkers, HA, MA and MHA noticed as the sequence of environmental levels of respective hydrocarbons. A better correlation observed between personal exposure to benzene and relative excretion SPMA than tt-MA.

RBC, platelet, hematocrit significantly decreased in fuel fillers with respect to control population. PBG in lymphocytes was significantly elevated ($P<0.05$) in fuel-fillers compared to control. Higher Hb obtained among traffic police possibly due to COHb content in blood. ALA and PBG in lymphocytes of traffic policemen were 0.090 ± 0.062 μg/10^6 and 0.151 ± 0.083 μg/10^6 lymphocytes respectively and were higher than non-exposed population. DNA damage ranging from negligible to high were noticed among the fuel fillers by comet characters in lymphocytes.

Study of 45 petrol pump workers of age groups, ≤35 years (n=26) and >35 years (n=19). Showed PFT values, significantly higher in age group, ≤35 years compared to >35 years. PFT impairments observed among 11.11% petrol pump workers, restrictive type impairments 6.66% and obstructive and combined restrictive and obstructive type impairments, 2.22% each. PFT of 84 traffic police showed significantly higher SVC, FVC and $FEF_{0.2\text{-}1.2l}$ values in non-smoker compared to smokers. The mean FEV_1, $FEV_{1\%}$ and $FEF_{25\text{-}75\%}$, $FEF_{75\text{-}85\%}$ and PEFR, values were higher in non-smokers but the differences were not statistically significant. The variation in PEFR, FEV1 and FVC of traffic police were significant compared to the control. Significant respiratory impairment of traffic policemen was mainly due to exposure to vehicular pollution.