Advanced Personal Particulate Matter 2.5 and Nitric Oxide Exposure Assessment for Patients With Asthma and Chronic Obstructive Pulmonary Disease in an Urban Air Pollution Hotspot in Stuttgart, Germany, Using Innovative Air Quality Sensors

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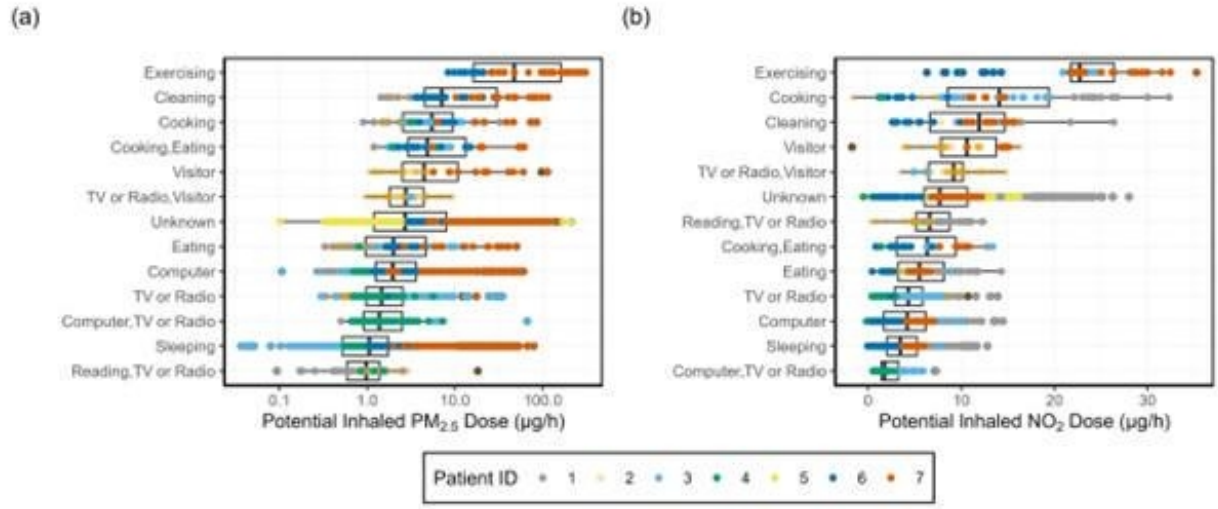
RATIONALE: Recent advancements in sensor technology for air pollution monitoring present further opportunities in order to bridge the data gap between exposure and respiratory health, especially in urban/industrial air pollution hot spots. Therefore, this pilot study evaluates the feasibility of using air quality sensors for assessing personal exposure to NO_2 and $PM_{2.5}$ of patients with chronic obstructive pulmonary disease (COPD) or asthma in order to investigate relations between their local exposure (indoor/outdoor) at home and their burden of respiratory symptoms. **METHODS**: We recruited seven patients (25-76 years), with COPD or asthma, who didn't require supplemental oxygen therapy, and lived at the urban air pollution hotspot at a very busy main road in Stuttgart/Am Neckartor. The air quality was monitored using custom-built air quality sensor systems (B43F and OPC-R1, Alphasense/UK) inside the living room and outside on the balcony or at the window during a period of 30 days. Machine learning techniques were used to calibrate the data of the sensors constantly. A health questionnaire was used, based on the Asthma Control Test and COPD Assessment Test. Patients recorded their indoor activities, time spent at home, window status at hourly basis, filled out the health survey and conducted peak expiratory flow tests on a daily basis. Potential inhaled doses of $PM_{2.5}$ and NO_2 were calculated using inhalation rates (ventilation volume per minute) based on the information collected in the logbook and the measured indoor $PM_{2.5}$ and NO_2 exposition. We assessed the correlations between indoor and outdoor air quality and the activity-dependent personal exposure indoors. **RESULTS**: The individual exposure ($PM_{2.5}$/NO_2) strongly depended on indoor air quality, taking into account the individual activities (Fig1). This differs from the calculated exposure, based on outdoor measurements significantly ($p<0.05$). The used health questionnaire captures the burden of symptoms and its fluctuations in a reproducible and sensitive manner, and thus provide credible and reliable results. Even with varying disease severity, there are sufficient intra-individual fluctuations to document day-dependent deviations in symptom´s burden and related to the air quality.**CONCLUSION:** Our results suggest that a combination of the health questionnaire and local air quality sensors are able to enhance the personal exposure-symptoms assessment. This advanced assessment (indoor and outdoor) may be indicated in asthma and COPD patients with burden of symptoms, living in urban air pollution hotspots.Fig 1: (a) $PM_{2.5}$ and (b) NO_2 potential inhaled dose associated with activities. Patient values represented by colour-coded points.



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