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To Klara Slezakova <slezakok@fe.up.pt>
Date 2014-05-20 13:35

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Manuela Vieira da Silva
Chair of the Organising Committee of ICEH2014

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----------------------- REVIEW 1 ---------------------
PAPER: 152
TITLE: Exposure of 3-5-years-old children to indoor ultrafine particles: assessment of homes and schools
AUTHORS: Klara Slezakova, Catia Teixeira, Jimmy Fonseca, Simone Morais and Maria Do Carmo Pereira

----------- REVIEW -----------
The abstract can be accepted as is presented

----------------------- REVIEW 2 ---------------------
PAPER: 152
TITLE: Exposure of 3-5-years-old children to indoor ultrafine particles: assessment of homes and schools
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----------- REVIEW -----------
theme very interest to the congress.

Exposure of 3–5-years-old children to indoor ultrafine particles: assessment of homes and schools

Authors: Klara Slezakova[1, 2], Catia Teixeira[1], Jimmy Fonseca[1], Simone Morais[2], Maria do Carmo Pereira[1]

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Presentation Preference: Oral

INTRODUCTION:

Throughout the entire lives, humans are exposed to the particulates omnipresent in indoor air. Considering that most people spend the majority of their time indoors, the consequences of this exposure can range from insignificant to fatal and depend on many factors (type of particulates present, type of indoor environment, duration, and etc.). Whereas in the last two decades the scientific attention focused on health risks caused by exposure to particulate matter such as PM_{10} and $PM_{2.5}$, in the last years it has shifted towards ultrafine particles (UFP; i.e. particles smaller than 100 nm). UFP contribute very little to the overall particle mass but they dominate the number concentration. When compared to larger particles, UFP have higher surface area and larger concentrations of adsorbed (or condensed) toxic pollutants per unit mass (Diapouli et al., 2007). In comparison to larger particles, UFP also have higher deposition rates in the lower respiratory tract. The available epidemiological studies provide (though not consistently) evidence of adverse effects due to short-term exposure to ambient UFP, while information on long-term exposure is not yet available (Bekö et al., 2013). In addition, the combined effect of UFP high surface area and potentially toxic composition may promote both physical and chemical reactions inside the organisms that can too result in adverse health outcomes. UFP particles penetrate to indoor environments from outdoors. They also originate from various indoor sources such as cooking, tobacco smoking, candle and incense burning, the use of gas and electric appliances, hair spray, cleaning products, and furniture polish; chemical reactions such as those between ozone and terpenes can also generate UFP indoors (Morawska et al., 2013). The complexity of UFP exposure (spatial variability, different indoor sources, infiltration of UPF from various outdoor emission sources and seasonal variability in concentrations and composition; Sioutas et al., 2005) indicates the need to further study this pollutant in order to fully comprehend its impacts on human health. This is especially relevant for sensitive groups. Young children in particular are very susceptible population because they receive a higher dose of airborne particles relative to lung size compared with adults while at the same time their physiological and immunological systems are still developing (Sioutas et al., 2005). Children spend up to 23 h per day indoors moving between specific microenvironments, such as homes and schools where the levels of air pollution can differ significantly. Therefore, quantification of UFP in these specific microenvironments is important in order to correctly assess child overall exposure to UFP.

OBJECTIVE:

The aim of this work was to assess the exposure dose rate of pre-school children to UFP in indoor environments, namely in schools and homes.

MATERIALS AND METHODS:

The exposure dose to UFP particles were assessed in Portuguese 3–5-years-old children considering three different pre-schools (urban, rural), and five homes over the period of 70 days. UFP number concentrations in size range 0.02–1 µm were measured by condensation particle counters – TSI P-Trak™ using an intake flow of 0.7 L min^{-1} and UFP logging interval of 60 s. Various indoor school microenvironments (classrooms situated on ground and first floor; canteens; gymnasium, playrooms) and homes were evaluated. The characteristics of each studied micro-environment as well construction properties were registered. In order to better understand the impacts of outdoor UFP emissions to indoor, the levels of UFP were concurrently measured in ambient air (i.e. outdoors). During sample collection, a detailed record of room's occupancy, ventilation systems (door and window positions) and potential sources was kept. The daily activity patterns of children were analyzed throughout each day. In addition, school staff and parents were daily inquired regarding the occurrence of additional sources/activities. Locations in which the different activities happened during the day were identified. Total daily residence time of children spent in each micro-environment and the types of performed activities were registered. Each activity was characterized in terms of intensity level in order to assess the corresponding breathing rates (USEPA, 2011).

RESULTS AND DISCUSSION:

At two urban pre-schools the inhalation exposure dose rate of UFP for 3–5-years-old children ranged from 4.60–7.52×10^9 and 2.94–7.52×10^9 particles $kg^{-1}day^{-1}$. The exposure doses of UFP were approximately 1.5 times for older children (5 years) than for younger ones (3-4 years) as they spent approximately twice more time outdoors; older children also performed more frequently physical activities such as exercising, running, and playing (both indoors and outdoors) which were associated with the highest breathing rates and consequently led to higher inhalation doses of UFP. The estimated dose rates of UFP in children at the rural school were higher than expected (in a view of much lower indoor UFP concentrations at this pre-school) probably due to the considerably longer period spent outdoors. At rural pre-school, children spent approximately 40% of their school times outdoors (whereas it was 7-25% at urban schools) and the UFP dose rates due outdoor exposure accounted for 60% of the total school exposure, thus being at the highest proportion of all three pre-schools. These findings show that daily activity patterns influenced significantly the overall child exposure dose rates to UFP. Concerning the homes, high exposure dose rates were caused especially by contributions of UFP originating from indoor sources. Cooking, namely grilling, boiling, use of an electric stove and a toaster were identified among the most significant exposure sources in homes.

CONCLUSION:

The results demonstrated that the levels of exposure to UFP in various indoor microenvironments differed significantly. Therefore, future population-based studies focusing on the health effects of airborne pollutants need to account for the exposures occurring in these different microenvironments in order to obtain a representation of child's overall exposure profiles.

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