

Indoor Air Quality in Austrian School Buildings: Influence on Respiratory Health of School Children

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Background: Children's Environment and Health Action Plan for Europe (CEHAPE) of WHO focuses (inter alia) on improving indoor environments where children spend most of their time. At present, only little is known about air pollution and in particular about semi-volatile compounds in schools.

Our project ("LuKi" study: Air and Children) was set up as an Austrian contribution to CEHAPE. It was designed to quantify indoor pollution in elementary schools. In a cross-sectional approach differences in indoor pollution were related to respiratory health problems.

Material and methods: Indoor air pollutants were monitored in nine elementary schools selected at random in different regions of Austria. Additionally, house dust and air samples of particulates were investigated. The screening covered semivolatile compounds in particulate matter and household dust (combustion products e.g. Polycyclic Aromatic Hydrocarbons, flame retardants such as Polybrominated Diphenyl Ethers [PBDEs] and trisphosphates plasticizers (i.e. phthalates). Moreover, volatile organic compounds were measured in air samples. Carbon dioxide, nitrogen dioxide, indoor humidity and temperature were monitored as well.

Respiratory health was determined by parents' questionnaires and lung function was assessed by spirometry.

Results: Overall 596 children (6 to 10 years of age) were eligible for the study. Spirometry was performed in 433 children.

In almost all school dust samples trisphosphates, PBDE and phthalates were found in concentrations above the average found in indoor household dust samples.

Tris(1,3-dichloro-2-propyl)phosphate (TDCPP) in PM₁₀, PM_{2.5} showed moderate but significant correlation with flow volumes. Formaldehyde, PBDE (congener 196) and

phthalates (benzyl-butyl-phthalat) in household dust showed a significant correlation to flow volumes (MEF75, MEF50).

Visible moulds and passive smoking at home decreased lung function, in particular endexpiratory flow volumes (MEF50, MEF25).

Discussion: Except for a few substances that are ubiquitously found in indoor air or house dust samples, environmental quality in these schools was better than in average households. Despite the long time spent at school the quality of home environment still plays a major role in children's respiratory health. Nevertheless, some air pollutants in schools had significant correlations with lung function, even though they were found in low concentrations.

Conclusions: While the quality of school environment has improved since the last study some concerns still exist. More interventions and inspections on schools will result in further benefits for children, especially in terms of flame retardants and plasticizers. Attention must be paid on control and management of the indoor environmental quality regarding construction, building maintenance and acquisition of teaching material (e.g., computers) and school supplies. A multi-faceted strategy to improve the school (and home) environment - with the participation of school authorities and parents - is needed. Parents' involvement in the process is strongly recommended as it would have a positive impact on the process and it would also contribute towards improving home environments.

When parents are engaged in such a process this could have an impact for the improvement of the home environment, too.

While the quality of school environment has improved some concerns still exist. Interventions in schools have the advantage that many children are affected. Especially in terms of flame retardants and plasticizers more attention must be paid on control and management of the indoor environmental quality concerning construction, building maintenance and acquisition of teaching materials (e.g. computer) and school supplies. A multi-faceted strategy to improve the school (and home) environment - with the participation of school authorities and parents - is needed. Parents' involvement in the process is strongly recommended as it would have a positive impact on the process. It would also contribute towards improving home environments.