Indoor exposure of Austrian school children to phosphororganic compounds influences their cognitive performance

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WHO's Children's Environment and Health Action Plan for Europe (CEHAPE) focuses on improvements of indoor environments where children spend most of their time. At present, only little is known about school environments concerning air pollution in particular with semivolatile compounds.

The project (LuKi-study: Air and Children) should quantify indoor pollution in elementary schools. In a cross sectional approach differences in indoor pollution were related to respiratory health and cognitive performance.

Indoor air pollutants were continuously monitored in 9 elementary schools in urban and rural regions of Austria. In addition, house dust and suspended particulates (PM_{10}, $PM_{2.5}$) were measured, focusing on semivolatile compounds (e.g. phthalates, phosphororganic compounds [POC]).

Respiratory health was determined by parents' questionnaire on environmental conditions and spirometry, cognitive function was measured by Standard Progressive Matrices (SPM).

Overall 596 children (6-8 years) were eligible for the study. Parents of 449 of these children answered the questionnaire. Spirometry was performed in 433, cognitive tests in 436 children.

Analysis showed significant correlations of tris(2-chlorethyl)-phosphate (TCEP) in PM_{10} and $PM_{2.5}$ and house dust samples with cognitive performance. Cognitive performance decreased with increasing concentrations of TCEP.

POC are widely used as plasticizer and flame retardants in different products. Besides neurotoxic effects certain POCs have been suspected to be tumorigenic. However, due to the great diversity of these substances toxicological assessment is far from being complete. Because production and waste management of these substances increase in Africa, minimising usage, search for alternatives and protective measurements are warranted.

Keywords: children's health, cognitive performance, indoor air pollution, phosphororganic compounds

Background: WHO's Children's Environment and Health Action Plan for Europe (CEHAPE) focuses on improvements of indoor environments where children spend most of their time. At present, only little is known about school environments concerning air pollution in particular with semivolatile compounds.

Methods and material: The project ("LuKi"-study: Air and Children) should quantify indoor pollution in elementary schools. In a cross sectional approach differences in indoor pollution were related to respiratory health and cognitive performance.

Indoor air pollutants were continuously monitored for two one-week periods in nine elementary schools in urban and rural regions of Austria. In addition, house dust and suspended particulates (PM_{10}, $PM_{2.5}$) were measured, focusing on semivolatile compounds (among them polybrominated diphenyl ethers, phosphororganic compounds [POC], phthalates).

Respiratory health was determined by parents' questionnaire on environmental and housing conditions and spirometry. Cognitive function was measured by Standard Progressive Matrices (SPM).

Results: Overall 596 children (aged 6-8 years) were eligible for the study. Parents of 449 of these children gave written consent and answered the questionnaire. Spirometry was performed in 433, cognitive tests in 436 children.

Analysis showed significant correlations of tris(2-chlorethyl)-phosphate (TCEP) in PM_{10}, and $PM_{2.5}$ and house dust samples with cognitive performance adjusted for relevant confounders. Cognitive performance decreased with increasing concentrations of TCEP.

Discussion: POC are widely used as plasticizer and/or flame retardants in different products, which appear in many indoor environments. Besides neurotoxic effects certain POCs have been suspected to be tumorigenic. TCEP is classified under the current international system of classification and labelling of chemicals (CLP) as a carcinogen (category 2: suspected of causing cancer). However, due to the great diversity of these substances toxicological assessment is far from being complete. Their intense use and ecotoxic properties such as in the case of TCEP chronic toxicity to water organisms and the potential to cause long term adverse effects in the aquatic environment, makes them also to environmental contaminants of concern. Because production and waste management of these substances increase in Africa, minimising usage, search for alternatives, and protective measurements are warranted.

Keywords: CEHAPE, children's health, cognitive performance, indoor air pollution, flame retardants, plasticizer, phosphororganic compounds, TCEP