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International Conference on Integrated Problem-Solving Approaches to Ensure Schoolchildren's Health

23-24 May, 2019. Budapest, Hungary

PROGRAMME

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Ministry of Human Capacities

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Plenary speakers

Éva CSOBOD (Regional Environmental Center, Hungary)

Claire DASSONVILLE (Scientific and Technical Center for Building, France)

Dorota JAROSINSKA (WHO European Centre for Environment and Health)

Greet SCHOETERS (VITO, Belgium)

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WHO Europe side-event coordinator

Irina ZASTENSKAYA (World Health Organization European Centre for Environment and Health)

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WELCOME

Air pollution is a major environmental health risk in both cities and rural areas. Indoor air quality is of paramount importance as people spend most of their time indoors. Primary school students, one of the most vulnerable groups, spend approximately 6-8 h daily in school buildings, thus the quality of the indoor air plays a key role in children's health and well-being.

We proudly announce the "**International Conference on Integrated Problem-Solving Approaches to Ensure Schoolchildren's Health**" which is organized within the framework of the InAirQ project (Transnational Adaption Actions for Integrated Indoor Air Quality Management) funded by INTERREG Central Europe. With this conference we would like to discuss the impacts of different aspects of the environment, especially the built environment, on the health and well-being of schoolchildren and to highlight the importance of stakeholders, scientists and decision makers. **Furthermore, we would like to continue the awareness raising on the importance of indoor air quality guidelines and legislations discussed in detail during the International Conference on Risk Assessment of Indoor Air Chemicals last year in Berlin, Germany.**

The topics to be discussed include, but are not limited to:

- Air pollutant concentrations indoors and outdoors
- Health effects, risk assessment
- Human biomonitoring
- Exposure control strategies, practices
- Architecture, design
- Communication, policy

We wish you a wonderful time at the conference and in Budapest!

InAirQ Hungary Team

BUDAPEST

The capital of Hungary, known by many as the "Pearl of the Danube", is undoubtedly one of the most beautifully located cities in the world. The River Danube runs through the middle of the metropolis of two million, dividing hilly Buda with its narrow-cobbled streets and mixture of mediaeval and neo-classical buildings from the flat area of Pest with its wide boulevards. The picturesque panorama offered by the river and its bridges, the Parliament building, the imposing Royal Castle, the Fishermen's Bastion and the impressive Danube Embankment led UNESCO to place this site on the World Heritage list.

Visitors will find side by side the remains of fortresses and buildings from Roman times, still-functioning Turkish baths, Gothic and Baroque buildings, and the incredibly rich Art Noveau architectural heritage. There is no other capital city in the world which can boast close to 100 thermal springs and 12 medicinal baths, where 19 million gallons of thermal water rise to the surface each day.

It is a city where the pleasing harmony of different architectural styles and superb structures, the cafés, gastronomy and culture are combined with the legendary Hungarian hospitality, blending into an unforgettable experience for visitors.

Budapest is the venue for numerous congresses, international meetings, sports competitions and cultural events, with its developed infrastructure, elegant shops and modern hotels. Budapest's cultural life is widely renowned, with more than 20 theatres and also ample to explore!

DETAILED PROGRAMME

23-24 MAY 2019, BUDAPEST, HUNGARY

23rd May 2019

13:00 – 14:00: Registration

Session I – Set the scene

14:00 – 14:15: Welcome – *representative(s) of the Ministry of Human Capacities and the WHO*

14:15 – 14:35: The WHO work on indoor air quality and health – *Dorota Jarosinska* (WHO European Centre for Environment and Health)

14:35 – 14:55: Austrian risk assessment concept for indoor air chemicals - *Maria Uhl* (Environmental Agency Austria, Austria)

14:55 – 15:10: Children's Respiratory Health Survey in Hungary - *Tamás Pándics* (National Public Health Center, Hungary)

15:10 – 15:25: Health and environmental education in Hungarian schools - *Márk Dombóvári* (National Public Health Center, Hungary)

15:25 – 15:40: The fairy tale kindergarten – *Károly Pólus* (Archikon Studio, Hungary)

15:40 – 16:10: Coffee break and poster view

Session II – The InAirQ project

16:10 – 16:30: Introduction to the InAirQ project and the main achievements - *Tamás Szigeti* (National Public Health Center, Hungary)

16:30 – 16:45: Transnational benefits and added values of the InAirQ project - *István Ferencsik* (PlanIdea Knowledge Centre, Hungary)

16:45 – 17:00: Outcomes of the vulnerability and SWOT analyses - *Anna Páldy* (National Public Health Center, Hungary)

17:00 – 17:15: The Prague intervention study - *Bohumil Kotlík* (National Institute of Public Health, Czech Republic)

17:30 – 17:45: How can we create a healthy school environment? - *Anja Jutraž* (National Institute of Public Health of Slovenia, Slovenia)

17:45 – 18:00: The role of communication activities in indoor air quality improvement - *Stefano Fraire* (LINKS Foundation, Italy)

Day 2 - 24th May 2019

Session III – Trends in indoor and outdoor air quality

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8:50 – 9:10: Indoor air quality in French schools: a nationwide study (2013-2017) - *Claire Dassonville* (Scientific and Technical Center for Building, France)

9:10 – 9:25: Exposure to biological agents in school environments in Hungary: special focus on fungi - *Donát Magyar* (National Public Health Center, Hungary)

9:25 – 9:40: ClairCity: Citizen-led air pollution reduction in cities – *Péter Szuppinger* (Regional Environmental Center, Hungary)

9:40 – 9:55: HungAIRy: a new initiative to improve ambient air quality in Hungary - *Lóránt Riesz* (Herman Ottó Intézet Nonprofit Kft., Hungary)

9:55 – 10:25: Coffee break and poster view

Session IV – Health aspects of pollutants and awareness raising

10:25 – 10:45: HBM4EU, advancing human biomonitoring in Europe – *Greet Schoeters (VITO, Belgium)*

10:45 – 11:00: Environmental exposure of children to lead: past, present and future - *Péter Rudnai* (National Public Health Center, Hungary)

11:00 – 11:15: Risk assessment for exposure to lead in drinking water - *Zsuzsanna Bufa-Dőrr* (National Public Health Center, Hungary)

11:15 – 11:30: Advancing water, sanitation and hygiene in schools in the WHO European Region - *Márta Vargha* (National Public Health Center, Hungary)

11:30 – 12:00: Recycling air pollution into ink and other materials, and it's global impact - *Anirudh Sharma and Mourvi Sharma* (Graviky Labs Inc., India)

12:00 – 12:10: Closure of the conference

12:10 – 13:00: Lunch break and poster view

24th May 2019

WHO Regional Office for Europe workshop - "Assessment of combined exposure to hazardous chemicals in indoor air in public settings for children" & 5th InAirQ Working Group workshop

13:45 – 13:55: Opening of the workshop – *representative(s) of the National Public Health Center and the WHO*

13:55 – 15:00: ***Session I – Towards a tool for assessment of risks of combined exposure to multiple chemicals in indoor air***

Evidence of adverse effects of indoor air pollution in schools and kindergartens on children's health

Tamás Szigeti (National Public Health Center, Hungary)

Approach to the development of a tool for assessment of risks from combined exposure to multiple chemicals in indoor air

Irina Zastenskaya (WHO European Centre for Environment and Health)

Supplementary documents for promoting of collection information on children exposure to chemicals indoor air

Irina Zastenskaya (WHO European Centre for Environment and Health)

15:00 – 15:15: Coffee break

15:15 – 16:30: ***Session II - Practical exercise on assessment of combined exposure to hazardous chemicals in indoor air***

Facilitated by *Irina Zastenskaya* (WHO European Centre for Environment and Health)

Revision of questionnaire for prioritizing schools for indoor air quality monitoring

Pilot assessment of risks from combined exposure to hazardous chemicals in indoor air

Abstracts of lectures

Session I

Set the scene

Adria Fodor (14 éves)
Soltvadkert, Hungary

The WHO work on indoor air quality and health

Dorota JAROSINSKA; Irina ZASTENSKAYA

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Keywords: *indoor air pollution, chemicals, risk assessment, WHO*

Indoor air quality in different settings, such as homes, kindergartens, schools, health care facilities, workplaces is an important health determinant. Outdoor air pollution and many indoor sources can affect indoor air quality and pose risk to human health. Globally, combustion of solid fuels for heating and cooking is a major source of indoor air pollution, affecting more than 3 billion people. Second-hand smoke still takes a high toll on human health; in the WHO European Region, more than 50% of children under the age of 15 years are exposed inside the home. Of big concern are hazardous chemicals emitted from building and finishing materials, indoor goods and appliances, etc. Combined exposure to chemicals indoors can affect human health, especially in vulnerable groups, such as children.

To guide actions in Member States, WHO has developed air quality guidelines, including indoor air quality guidelines on dampness and moulds, and on selected chemicals; guidelines on household fuel combustion bring together the relevant evidence and provide practical recommendations. The WHO Framework Convention on Tobacco Control is a highly effective, yet underutilized regulatory instrument.

Measures to address a multifaceted challenge of indoor air pollution need to be part of the transformation towards the sustainable development and creation of healthy environments. The draft WHO global strategy on health, environment and climate change identifies settings, such as schools, homes, workplaces and health care facilities, as key sites for interventions, including those to improve indoor air quality.

To facilitate actions, WHO supports Member States through developing methods and tools, and strengthening capacities. The evidence from the WHO European Region shows challenges in the implementation of the policies for healthy indoor environments for children in schools and kindergartens; exposure data are sparse, and much effort is needed to reduce emissions, improve enforcement of existing smoking bans, provide adequate ventilation, etc. To support actions on hazardous chemicals indoors, the WHO European Centre for Environment and Health is working to develop a decision support tool to assess the combined risks of chemicals in indoor air at schools and other public buildings for children.

Austrian risk assessment concept for indoor air chemicals

Maria UHL[1]; Philipp HOHENBLUM[1]; Ilse MAURITZ[1]; Sigrid SCHARF[1]; Michael KUNDI[2]; Hanns MOSHAMMER[2]; Peter WALLNER[2]; Peter TAPPLER[3]; Bernhard DAMBERGER[3]; Felix TWURDIK[3]; Hans-Peter HUTTER[2]

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Keywords: *indoor air quality, health, children, all day schools*

The Austrian Working Group on Indoor Air (AWGIA) at the Federal Ministry of Sustainability and Tourism (BMNT, formerly BMLFUW) was founded in 1999 in order to establish guidance for the assessment of indoor air quality. Its members are experts from the technical and medical sciences as well as from administration, e.g. from the Climate and Air Quality Commission of the Austrian Academy of Sciences, the Austrian Social Insurance for Occupational Risks, experts from the Austrian Federal States. Following a long tradition of establishing guideline and limit values for major air pollutants - originally for outdoor air - guideline documents for selected indoor air pollutants are developed. The purpose is to aid experts who are familiar with the evaluation of a specific situation, and furthermore to give support for often far-reaching decisions. Besides the development of guideline values the Working Group issued statements on current issues in the field of indoor climate. These so called position papers serve as a fast response to urgent indoor air problems and challenges such as mechanical ventilation in schools or protection from passive smoking in bars and restaurants. Further, projects such as "air and children: the influence of indoor air quality on health of all day school children" have been conducted. Within this study in total 252 chemicals have been measured in air, particulate matter and house hold dust and the relationship of indoor air quality with health outcomes has been assessed. In conclusion, the last years of cooperation demonstrated that multidisciplinary work on this specific environmental health issue is absolutely necessary. Different view points produced a comprehensive and practicable guideline, which is now accepted by all experts working in the field of indoor air pollution. The standardized procedure and evaluation is only effectively applied because there is a broad acceptance of the final tool by the experts involved.

National Children's Respiratory Survey in Hungary

Tamás PÁNDICS

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Keywords: *respiratory disease, asthma, allergy, children, questionnaire*

The National Institute of Environmental Health (at present National Public Health Center) conducted surveys in 2005 and 2010 (National Children's Respiratory Survey) to assess the frequency of chronic respiratory and allergic diseases and symptoms, as well as to investigate the most important environmental risk factors for them in order to help develop prevention programmes for the protection of children's health and focused regulation for indoor air quality in public buildings for children.
The questions of the surveys with regards to health status were translated, adopted, and extended versions of questions from large international studies (the ISAAC, PEACE and CESAR studies).
The number of adequately completed questionnaires that were returned to the institute in 2005 and 2010 were 62 711 and 67 667 respectively. The data entry, its processing, assessment, and the analysis of the interrelations were also performed by the institute's experts.
The survey was repeated in 2017 in an extended form. The aim was to obtain more detailed data on diseases and risk factors and to observe the changes by comparing the new data with those of the previous studies, as well as to determine the effectiveness of the environmental health policies, and to corroborate new suggestions with scientific data.
The survey was completed by parents anonymously. It contained questions about the present and past health status of the child, their home environment (construction material, housing, painting, pets, mould, and population density), their eating habits, activities, and the health status of the parents, their smoking habits, and their socio-economic status. The analysis of the data is still in progress.

Health and environmental education in Hungarian schools

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Keywords: *School Health Promotion, curriculum development, healthy environment*

A new School Health Promotion curriculum is being developed in the Hungarian National Public Health Center within the framework of the "Methodological Developments in the Health System" project in Hungary. Existing health promotion programs usually focus on one dedicated area of health and use traditional teaching methods, which makes them inefficient and outdated. In accordance with the modern view on health promotion, we aim to create a curriculum that emphasizes the holistic nature of health in teaching through interdisciplinary and problem-solving approaches.

A quantitative study has been conducted in ninety-seven schools with the participation of 5090 students and teachers. A qualitative study has also been conducted which consisted four in-depth interviews with public health experts and eighteen focus group interviews with teachers, health visitors, students and Health Promotion Office experts. The development of the curriculum is based on the results of this national research. We defined eight major subjects as the basis of the curriculum: physical activity and spinal health, nutrition, healthy environment, social relationships, digital world, addictions, health services and healthy future goals. We also defined mental health as a special subject which is embedded in the other eight subjects throughout the curriculum. The lessons are currently being tested in 162 dedicated schools.

The subjects of this complex curriculum are intertwined with each other, but they are also interpretable in themselves. This systematized approach enables us to teach children about both indoor and outdoor environment and their interactions with it as a part of school health promotion. The healthy environment subject itself follows the international trends of this topic. We use critical thinking and problem-solving approaches to address various areas of the subject like environmental awareness, ecological knowledge, attitudes, values, commitments for actions and ethical responsibilities.

The fairy tale kindergarten

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ARCHIKON Studio, Budapest, Hungary

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Keywords: *kindergarten, passive house, sustainability, climate language*

Since September 2016 operates the very first "Darmstadt Passivhaus Institut" certified kindergarten of Hungary. It means not just tremendously reduced heating costs and special comfort, but thanks to the creative architectural programme the building sets an iconic milestone of its genre. The 13th district's board decided to develop a passive house kindergarten realized with a limited budget – diminished construction costs as well as lowered operational expenses. They commissioned Archikon studio whose statement is a deep engagement with irregular and experimental solutions, and beyond that sensitivity towards social projects. This project is the second passive house social investment of the local government, a 100 apartment social housing has been completed earlier in the district. The services offered by the building already ensure extras comparing it to the general state kindergarten standards: two gyms, salt therapy room, special education rooms, theatre stage. The large number of groups (16) indicated the idea to create one more playground which has been located on the top of the building, realized with colourful concrete curves. The yellow of these curved walls is the only strong colour applied on some specific surfaces such as the main staircase. This minimal attitude towards the colours is spiced with contemporary, tailored graphic design. In order to full-fill the requirements of the passive house standard the kindergarten was constructed with a thermal bridge free airtight and superinsulated building shell, passive house standard windows and doors with automatic shading system, led lights regulated by light and presence sensors, low-volume heat recovery comfort ventilation system which result an annual heating and cooling demand of not more than 15 kWh/m^2 total primary energy (source energy for electricity, etc.) consumption (primary energy for heating, hot water and electricity) not be more than 120 kWh/m^2 per year.

Session II

The InAirQ project

Hanna Róza Sipos (9 éves)
Balatonfűzfő, Hungary

Introduction to the InAirQ project and the main achievements

Tamás SZIGETI[1] and the InAirQ project team

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Keywords: *indoor air, children, school, health risk*

The quality of the air we are breathing in determines our health and well-being. Children spend approximately 6-9 h of their day in the school building, thus the IAQ inside these educational buildings is of paramount importance. Several international projects have been carried out in the past decades on the IAQ in schools; however, the proposed actions have rarely been implemented.

The main goals of the InAirQ project are to investigate the IAQ in primary school building in five Central European countries (Czech Republic, Hungary, Italy, Poland and Slovenia) and to develop and test actions to improve the school environment. Furthermore, we aimed to bring together the different stakeholders, such as researchers, policy makers and school managers, and to discuss and solve IAQ-related problems together.

Baseline analyses (i.e. vulnerability assessment and SWOT analysis) were carried out within the framework of the InAirQ project in all participating countries. The air quality was investigated in total 64 primary school buildings in 2017/2018. The results highlighted that the investigated IAQ parameters were in the inappropriate range in many cases. Both the carcinogenic and non-carcinogenic risks were calculated.

Based on the outputs of the baseline analyses, the monitoring campaign and benchmark visits, a joint transnational strategy for IAQ action plans has been elaborated and implemented by the project partner. Feasibility and intervention studies have been carried out based on the national action plans. Special attention has been paid to awareness raising (e.g., environment quality forum, awareness raising events, communication material, competition for schoolchildren).

The mission of the InAirQ project has not been finished yet, further actions must be taken to ensure healthy air in the school buildings.

Transnational benefits and added values of the InAirQ project

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Keywords: *Interreg, transnational cooperation, indoor air quality, joint actions*

Much progress has been made in the EU to improve outdoor air quality and reduce the emission of pollutants. However, indoor air quality in schools requires even more attention because it is the vulnerable place where our children spend most of their time.
The InAirQ project has described the health impacts of the indoor air quality on the school attendant population and taken action to improve the healthy environment in schools in the Central Europe Programme area.
The project has developed a tools to help the decision makers monitor the indoor air quality and its change. National action plans elaborated, tested and implemented to provide a set of measures to improve the indoor environment for the pilot schools and national/regional health control bodies. Capacity building courses have been organised, tailored to the school managers and local/regional school operating bodies for the best implementation of the action plans, while the Transnational Environment Quality Forum provides the follow up of the project results and sustain the co-operation to the potential stakeholders.
Partner national and regional health institutions have explored the baselines of the indoor air quality and its health impacts at transnational scale. Local and regional authorities, network of schools and the pilot schools have contributed to elaborating, testing and implementing the action plans. They have conducted capacity building activities. The project activities have been able to maximise the opportunities for cooperation and the pooling of experience and ideas at the transnational level.

Outcomes of the vulnerability and SWOT analyses

Anna PÁLDY[1]; Péter RUDNAI[1]; Anna KOZAYDA[2]; Tamás SZIGETI[1]

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Keywords: *vulnerability assessment, SWOT analysis, legislation, monitoring air exchange*

Air pollution is one of the main challenges for future generations. The InAirQ project is dedicated to investigating indoor air quality (IAQ) in primary school buildings and to plan actions to ensure children`s health and well-being at school in Central Europe. The aim of the baseline analyses was to provide a sound basis for the national action plans covering the problems in school buildings and providing solutions to improve the indoor environment.

National vulnerability assessments were prepared to review the quantitative and qualitative aspects of the primary school domain and the existing policies in the participating countries. Each project partner prepared a SWOT analysis focusing on the country-specific aspects.

The mean number of pupils per classroom varied between 20 and 25 and overcrowded classrooms were reported in several cases. Regarding the age of the school buildings, the highest proportion of old buildings (built before 1900) were found in the Czech Republic (22%). The most common building material was brick. Concrete was used at the highest rate (40%) in Slovenia compared to other countries (21-28%). Legislation exists only in the Czech Republic defining hygienic limit values for chemical, physical and biological indicators of residential rooms, accompanied by decrees on the requirements for educational establishments. There are no special guidelines on monitoring indoor air quality in schools in any of the partner countries.

A SWOT analysis showed the need for (i) the forced involvement of school staff and parents to take actions; (ii) national legislations; (iii) the regular monitoring of IAQ; (iv) optimizing the air exchange rate and (v) for the use of low emission building materials.

There is a need to prepare national action plans aiming at controlling and improving the indoor environment of schools.

The Prague intervention study

Bohumil KOTLÍK; Helena KAZMAROVÁ; Miroslava MIKEŠOVÁ; Věra VRBÍKOVÁ; Linda KUKLOVÁ

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Keywords: *indoor, air, school, traffic, sensors*

One of the tasks of the InAirQ project solved in the Czech Republic was to describe the potential impact of transport on the indoor environment in schools and the proposal / verification of possible measures. For this intervention study on the influence of the surrounding traffic load, a school in Prague was selected. In its immediate vicinity there are high traffic streets Bělohorská and Patočkova and two city traffic ring tunnels (the Blanka Tunnel and Strahov Tunnel – in common more than 85 thousand car/24 hours).

It was obvious from the initial weekly measurements carried out in schools that there was no problem with radon, metals and organic substances. Moreover, in the ambient air no higher concentrations of benzene, carbon monoxide or sulfur dioxide were measured at the schools.

The influence of ambient traffic load has always been manifested by nitrogen oxides and dust, $PM_{2.5}$ and submicron fraction. In the school environment, excesses in the case of dust ($PM_{10/2.5}$) and (dis)comfort parameters, i.e. relative humidity, temperature and air exchange rate (CO_2 indicator) were identified. Accordingly, for the long-term measurement we used 12 NODE sensor systems to measure CO_2, temperature, relative humidity and $PM_{2.5}$. Sensors were verified by accredited reference analyzers. The data was transmitted by WI-FI and the web interface provided its primary processing.

To improve the situation at the school, measures were proposed, and the measured values and the effect(s) of the proposed measures will be presented.

How can we create a healthy school environment?

Anja JUTRAZ[1], Andreja KUKEC[2]

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Keywords: *healthy school environment, indoor air quality, primary schools, interdisciplinary collaboration, public health*

Kids spend in school in average around 8 hours per day, thus it is really important how we design and maintain school environment. The physical environment must be safe, welcoming and support learning. Moreover, good school environment influences different dimensions of our health. Through the entire life cycle of the building following microclimate parameters have to be considered: noise, lightening, space distribution, orientation in the space, thermal comfort, air quality, furnishing. In the design phase there is a big need for interdisciplinary collaboration between different experts, where also public health experts should have an important role. In the maintenance phase monitoring of different parameters is needed (for example indoor air quality parameters), and also regular inspections are necessary. Moreover, special attention should be paid to awareness raising between different stakeholders. The main aim is to show the importance of designing the quality-school environment for health of employees and users and define the guidelines for designing healthy school environment from public health and architecture view.

Our research was based on literature review and benchmark visits of different primary schools in Austria and Finland in 2018 and 2019.

Based on the benchmark visits we defined different elements that should be considered when designing healthy school environment: process (cleaning process, maintenance, monitoring comprehensive approach), technical elements (natural ventilation, mechanical ventilation, furniture, flooring, etc.), curriculum and legislation. Additionally, we defined different action plans that could be used in existing buildings as part of renovation process.

To conclude, a holistic approach is needed in the planning process of school buildings, which is based on interdisciplinary collaboration between different stakeholders, from planners (architects, engineers etc.) to public health experts.

The role of communication activities in indoor air quality improvement

Stefano FRAIRE

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Keywords: *communication, information, air quality, indoor*

The paper/presentation aims at providing the audience with relevant information about the role of communication activities in indoor air quality improvement describing the methodology that has to be followed, the best ways of communication suggested and the results obtained by InAirQ project team.
The role of Communication and providing Information on indoor air quality is essential to make effective the actions decided at project/plan level, especially because many of them are influenced by users' behavior. This activity can be seen as a one way process: a sender 'issues' messages without being concerned if the message 'arrives'. However, if the sender does want to have an impact with his messages he must take certain things into account:

- choose an information transmission method that arrives at the intended target group, at the right time;
- make sure that the target group understands and appreciates the messages-information (this implies that the sender has to know what is relevant for the intended audiences).

The only way the sender can make sure of the result is by soliciting feedback from the receiver: a two-way exchange of information called 'communication'; a dialogue aimed at satisfying both the receiver and the sender of information. From this example, it is possible to understand that the method requires careful consideration of the goals and objectives of the activity, the target audience, the type of information, the messages to be conveyed, and the vehicles through which the message will be delivered. Because the goal of communication is not only gives information about indoor air pollution to the public, but also to promote changes in the behavior of various target groups (in the project mainly pupils and schools staff).

NOTES

Session III

Trends in indoor and outdoor air quality

Lili Ágnes Fazekas (15 éves)
Hajdúböszörmény, Hungary

Lessons learned from the SINPHONIE project: Air quality in schools and childcare settings

Éva CSOBOD

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Keywords: *children's exposure to indoor air pollutants, climate change, risk assessment*

Objectives of the action:
The SINPHONIE project was designed to run for two years and the consortium was made up of 38 partners from 25 countries, with one associated partner from Belgium. SINPHONIE is a complex research project in the fields of health, environment, transport and climate change, aimed at improving air quality in schools and kindergartens.
The SINPHONIE project, with its special focus on schools and childcare settings, aimed to capitalise on existing knowledge and information and to extend the range of information available, covering old and new EU member states and some accession countries using a standardised procedure to be able to produce a set of policies, guidelines and good practices that ensure the best indoor environment for children in schools.
Gaining an understanding of children's exposure to indoor air pollutants, and evaluating the associated health risks, are prerequisites for providing policy recommendations. Research of this nature involved monitoring indoor environments; undertaking the toxicological assessment of chemical hazards; and monitoring health impacts.

Short summary of conclusions:
Many countries in Europe have legislation in place that directly or indirectly aims to improve the health of school children and staff. Many countries, however, do not have legislation in place. By analysing this information and the common aspects and differences, criteria were established to support the prioritisation of possible measures. Possible measures fall into five categories: 1) hygienic requirements for cleaning procedures and frequency; 2) awareness raising; 3) good ventilation practice; 4) the use of products/materials; and 5) technical intervention.
The SINPHONIE project, supported by the European Parliament and coordinated by DG SANCO, was the first pilot project to monitor the school environment in parallel in 25 European countries. (2010-2012, reporting: 2014). The project partners are committed to the follow up of the project in Europe. www.sinphonie.eu

Indoor air quality in French schools: a nationwide study (2013-2017)

Claire DASSONVILLE, Anthony GRÉGOIRE, Sutharsini SIVANENTHAM, Bruno BERTHINEAU, Mickaël DERBEZ, Olivier RAMALHO, Jacques RIBERON, Corinne MANDIN

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Keywords: *$PM_{2.5}$, VOC, SVOC, stuffiness, children*

From 2013 to 2017, the French observatory of indoor air quality carried out a nationwide survey in schools to describe indoor environment quality in classrooms with three objectives: i) description of the buildings, equipment and systems (i.e., heating, ventilation, lighting) and use by the occupants (window openings, occupancy rate, activities, cleaning frequency, etc.); ii) assessment of comfort parameters (CO_2, temperature, relative humidity), indoor air concentrations (VOCs and SVOCs, aldehydes, NO_2, $PM_{2.5}$) and settled dust concentrations (metals and SVOCs), as well as lead in wall paint; iii) assessment of overall comfort: thermal, acoustic, and visual.
A sample of 300 schools was randomly selected from the stock of around 67 300 nursery and elementary schools in mainland France. A three-stages sampling allowed to extrapolate the observed data to the stock of schools in France. The recruitment/inclusion of selected schools took place from May 2012 to April 2017. 301 school principals accepted to participate to the study. In each school, two classrooms were randomly drawn. Field studies were conducted from June 2013 to June 2017 over the school year (September to June) excluding holidays. Measurements were performed in each studied classroom over one school week from Monday morning (8:00 am) to Friday afternoon (5:00 pm). VOCs, aldehydes and NO_2 were sampled with passive samplers. $PM_{2.5}$ and SVOCs were sampled through active sampling.
The major part of schools met French formaldehyde and benzene regulatory threshold values, 100 $\mu g/m^3$ and 10 $\mu g/m^3$, respectively. $PM_{2.5}$ were ubiquitous, with concentrations exceeding the WHO guideline value (2005) in 96% of schools. Some SVOCs, including phthalates, PAHs and an organochlorine pesticide (lindane) were detected in 100% of schools. Finally, air stuffiness index (ICONE) was very high, i.e., equal to 4 or 5, in a least one classroom in 40% of schools.

Exposure to biological agents in school environments in Hungary: special focus on fungi

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Keywords: *indoor air, fungi, viable sampling, allergy*

Long-term exposure to indoor air pollution could lead to respiratory diseases, such as allergy and asthma. Children aged 6 to 14 represent one of the most sensitive groups, spending 6-8 h daily in classrooms. Air samples were collected in 22 primary schools (34 classrooms and outdoors) in 11 towns in Hungary with a single-stage Andersen device. Two samples per classroom were taken during the lessons with closed windows and doors onto malt extract agar with 10% chloramphenicol and incubated at 25 °C for 5 days. Threshold levels were defined as the concentration (colony forming units/m^3) higher than the corresponding outdoor concentration of a given fungal sp. by 50. Sporulating filamentous fungi were identified at the genus level with a Carl Zeiss Jenaval light microscope at 300×. Airborne levels of moulds exceeded the threshold value in 9 schools (13 classrooms). *Penicillium* (36%), *Cladosporium* (29%), *Alternaria* (14%), *Aspergillus* (14%) and *Acremonium* (7%) spp. reached high concentrations. Many species of *Penicillium* are common indoors and are food-borne fungi. Remnants of mouldy foods in schoolbags might be a major source of this fungus in classrooms. *Alternaria* and *Cladosporium* are common outdoor fungi, but the latter one often grows in areas of condensation, where it is frequently associated with *Acremonium* spp. *Aspergillus* spp. (especially spp. of the section *Versicolores*) are frequent in damp buildings. Their high concentration could be regarded as an indicator of fungal growth in schools. The above-mentioned fungi can trigger respiratory diseases such as allergy and asthma. Other biological agents, such as bacteria in Hungarian schools are also reviewed. Based on these results it is important to improve microbial air quality in schools.

This work was implemented within the projects SINPHONIE (Schools Indoor Pollution and Health, initiated and funded by the European Parliament) funded by DG Sanco, Health and Consumer Protection Directorate and InAirQ (Transnational adaption actions for integrated indoor air quality management) funded by Interreg CENTRAL EUROPE.

ClairCity: Citizen-led air pollution reduction in cities

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The CLAiR-City project aims to substantially improve future air quality and carbon policies in European cities by initiating new ways to engage citizens, stakeholders and policy makers. The goal is to generate fundamentally new insights into the integration of citizens and stakeholders into air quality policy making.
Sources of air pollution emissions will be apportioned not only by technology, but also by citizens' behaviour and daily activities. Using an innovative quantification and engagement toolkit to facilitate multi-stakeholder dialogue in six European pilot cities, the project will enable citizens and other stakeholders to discuss the role of air quality and carbon policies for citizens' health, well-being and future quality of life. The results of this dialogue and engagement process will be evaluated and will provide policy input at city, national and EU levels. The toolkit itself will target all EU cities with over 50,000 citizens.

Some of the activities of the project:

- developing an innovative and interactive game, app and competition to enhance citizens' understanding of the connections between their behaviour and air quality, carbon footprint and health impacts;
- developing a quantification toolkit that helps to apportion responsibility for air pollution, carbon emissions and health outcomes not just by source but by behaviour and activity, in order to help citizens, understand the impact of their decisions and actions on air quality, carbon emissions, exposure and health;
- raising awareness of environmental challenges and their solutions through the proactive dissemination of outcomes, including case study results, to EU cities; city, national and EU policy makers; and the public.

EU founded H2020 research and innovation project in the period of May 2016 – April 2020. www.claircity.eu

HUNGAIRY: a new initiative to improve ambient air quality in Hungary

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Keywords: *air quality, municipalities, life ip, air quality plan, hungairy*

Towns and cities in Hungary have been unable to meet limits for particulate matter and other airborne pollutants established by the EU Air Quality Directive. To tackle this challenge, 10 municipalities across 8 of the country's regions will implement measures set out in regional air quality plans. The project will install automated monitoring stations, establish a network of air quality consultants and eco-managers and build capacity among decision-makers at regional and local level, for instance through training to use tools to assess the impact of local policy decisions on air quality. Information campaigns will encourage citizens to change the way they heat their homes and get from place to place. The project will give municipalities the ability to make use of €326.5 million of complementary EU funding to update residential heating systems, and develop sustainable public transport and infrastructure for cycling and electric vehicles.

Section IV

Health aspects of pollutants and awareness raising

Maja Csuha-Dankó (9 éves)
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HBM4EU, advancing human biomonitoring in Europe

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Keywords: *HBM4EU, human biomonitoring, chemicals, policy*

Twenty eight countries join their expertise to coordinate and advance human biomonitoring in Europe, in the 5 years HBM4EU project co-funded by the European Commission and the participating partners. HBM4EU generates evidence of the actual exposure of citizens to chemicals in order to support policy making. A unique feature of the project is the collaboration between scientists and policy makers, including several Commission services, EU agencies and representatives from the national level. They collaborated for prioritisation of chemical substances and research activities to target policy demands. Stakeholder collaboration continues to facilitate uptake of scientific results to support chemical policies in Europe and hence protect health of European citizens. Data on internal exposure to chemicals collected all over Europe are brought together for joint data analysis. Study centers in 21 countries collect and analyse new samples in a harmonized way in three age groups to obtain comparable biomarker results. A network of analytical laboratories is being organized that are qualified to deliver comparable and high quality exposure biomarker results for 18 priority substance groups. Occupational studies focusing on exposure to chromium are collecting samples in 8 countries. In 5 countries samples are collected to study exposure to pesticides in mothers and children living in the neighborhood of orchards. Interpretation of biomonitoring results is further supported by exposure modelling and physiologically based pharmacokinetic modelling, mechanistic studies, implementation of effect markers and improving novel analytical techniques to screen for emerging chemicals and their metabolites in human samples. The project is building bridges between the research and policy worlds in order to deliver benefits to society in terms of enhanced chemical safety. The project has received funding from the European Unions´ Horizon 2020 research and innovation programme under grant agreement No 733032 HBM4EU (www.HBM4EU.eu).

Environmental exposure of children to lead: past, present and future

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Keywords: *lead, children, human biomonitoring*

Lead is associated with a wide range of toxicity in children and there is no known safe blood lead (PbB) level in children. Environmental exposure of children to lead may originate from multiple sources (petrol, industrial processes, paint, solder in canned foods, water pipes) and pathways (air, household dust, street dirt, soil, water, food). Relative contribution of sources is complex and likely to differ between areas and population groups. In most of the European countries the main source of environmental lead exposure used to be leaded petrol. Tetra-ethyl lead was used extensively from the 1930s to the 1970s as a petrol additive to improve engine performance, comprising major part of atmospheric lead which was a significant contributor to the body burden of lead. Phasing out lead from petrol, formerly in Western European countries then later in Central and Eastern Europe as well, has resulted in significant decrease of blood lead levels in children. Earlier disregarded sources of lead exposure became more and more significant, like drinking-water systems with lead solder and lead pipes, lead in products, such as herbal and traditional medicines, folk remedies, cosmetics and toys; lead released by incineration of lead-containing waste; lead in electronic waste (e-waste); lead in the food chain, via contaminated soil; lead contamination as a legacy of historical contamination from former industrial sites. A proper surveillance system is needed for monitoring the children's blood lead level and to identify and eliminate remaining sources of lead exposure and to monitor the efficiency of the efforts done for preventing children's further exposure to this toxic metal.

Risk assessment for exposure to lead in drinking water

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Keywords: *lead, drinking water*

In the National Public Health Center (hereinafter: NPHC) a complex public health project EFOP-1.8.0-VEKOP-17-2017-00001 was launched, a part of which is the assessment and evaluation of lead exposure from drinking water to the population. The main aim of the project is to reduce the lead exposure of the population, give personalized risk assessment and advice, and to make health-promoting communication to public.

Lead is a secondary pollutant, usually not present in the raw water; however, due to migration from sources in the water supply system in buildings, it can occur in the tap water in concentrations above the limit value (10 μg/l). The primary source of lead is lead pipes, but it can have other sources, such as copper alloys, galvanized steel, soldering materials, and also some plastics. As a result, the main risk is buildings built before 1945, where lead pipes may still be present. Some parameters of water also influence how much lead is dissolved in drinking water, like its quality and stagnation time. One of the tasks of the project is to assess which geographical areas and what proportion of the population are affected by lead content above the limit value in tap water.

Among the health effects of lead exposure by tap water are the harmful effects on the mental development of foetuses and young children can be highlighted. For the high risk groups (living in old buildings, having small children, pregnant women) NPHC started the "open laboratory program", a water testing possibility free of charge.

Based on the results of the regular monitoring of drinking water (so-called compliance monitoring), the proportion of lead-containing samples above the limit value (10 μg/l) is around 1 to 2 percent, whereas the results from our "open laboratory" show that in the apartments in old buildings it may exceed 20 percent.

Advancing water, sanitation and hygiene in schools in the WHO European Region

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Keywords: *school, water, hygiene, sanitation, Europe, education*

Advancing water, sanitation and hygiene (WASH) in schools is critical for children's health and learning opportunities and a regional and global commitment, included in the Ostrava Declaration of the Sixth Ministerial Conference on the Environment and Health and the Sustainable Development Goals. A recent analysis in the WHO European region indicated that although the availability of WASH services in schools is increasing, there are still common problems regardless of the economy of the countries – including inadequate school policies, difficult operation and maintenance and low acceptability by pupils.

Hungary conducts routine public health surveillance in childcare institutions. The results indicate similar challenges as observed in in other parts of the region: though all schools are connected to public drinking water supply and sanitation, there is room for improvement in hygienic conditions, supply of consumables and, in some cases, drinking water quality (lead).

The Protocol on Water and Health (1999), a multilateral regional instrument, aims to reduce water-related diseases by improving water management. Under the Protocol's programme, WASH in schools is a priority area co-lead by Georgia, Moldova and Hungary, and supported by the WHO Regional Office of Europe. In this framework, building on the situation analysis, several tools have been developed on WASH in schools addressing the health and education sector. The objective is to raise awareness of beneficial health and learning outcomes of good WASH (e.g. increased cognitive functions as a result of good hydration or reduced absenteeism after improved hand hygiene) and advocate for action at all levels: prioritization on the national political agenda; assisting school managers in implementing improvements and public health authorities in efficient surveillance. All these efforts put emphasis on reflecting pupils' needs and perspective.

Meeting national, regional and global ambitions on WASH in schools requires coordinated action of the health and educational sector.

Recycling air pollution into ink and other materials, and its global impact

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The global burden of disease is a comparative assessment of the health impact of the major and well-established risk factors, including ambient air pollution. Among the air pollutants, fine particulate matter is the major contributor to premature death and chronic diseases. There are several sources of particulate matter including the incomplete combustion of wood and fossil fuels, forest fires, construction activities, natural sources and the particles can also be formed in the air by precursors. The particles originating from combustion processes are usually rich in carbon, which can be used as a resource and can be sequestered as high-grade pigment. It can help to reduce the black ink and coatings industry's dependence on black carbon which is made by the deliberate burning of fossil fuels.

AIR-INK™ is the world's first commercial grade ink to be created from air pollution. It addresses two problems related to air pollution and circular economy:

- it prevents the dumping of particulate matter into air and water;
- it replaces black carbon in the ink-making process, thereby aiding the printing industry in reducing its dependence on fossil fuels.

Source: Graviky Labs Inc.

Abstracts of poster presentations

Bernadett Kata Lipták (11 éves)
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Development and implementation of a user-friendly IAQ checklist for ensuring healthy households for children

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Keywords: *building checklist; household air pollution sources; indoor air quality; source control*

Ensuring safe and healthy environments for children is key to ensuring all children grow and develop healthily. Prevention of pollution in indoor environments where children spend a substantial part of their time, particularly homes and schools, constitutes a major opportunity for improvement of IAQ and promotion of public health.

In this work, a checklist was developed to collect harmonized data on potential pollutant sources to air in the indoor environment of households of families with children, with special focus on the bedroom of the newborns. The tool was implemented in the context of a European pilot exposure and health survey. In the Portuguese cohort of the study, the application of the tool was very effective in providing data on energy use and on the putative air pollution sources in the households of 309 families with newborn babies living in Porto. The results of the analysis of the collected data suggest that, for the population under study, the main concerns on children's exposures at home can be related to emissions from the use of household solid fuels, indoor tobacco, household cleaning products, fragranced consumer products (e.g. air fresheners, incense and candles), moisture-related pathologies and traffic-related outdoor pollution.

As an extension of this work, in order to collect comprehensive data on children's exposures, a framework for producing a web-based platform that provides user-friendly tools for collecting data on IAQ also in kindergartens, schools and swimming pools is being planned. The widespread use of the tool by local stakeholders will allow to: i) ascertain the main putative pollution sources in each indoor environment and guide the development of a list of recommendations and best practices; ii) identify priority sites for sampling and/or intervention (buildings presenting most evident IAQ problems); and iii) empower parents to play an active role in achieving healthy living environments for their children.

Radon as a special indoor air pollutant – Radon in Hungarian homes, schools and kindergartens

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Keywords: *indoor radon, radiohygiene, ionising radiation*

The radon is the second leading contributor to the lung cancer disease after the smoking among the general public. According to the international reports, we spend 80% of our time in indoor spaces and everybody is exposed to radon in indoor spaces during the whole life-time. In the last two decades, there was a bigger attention on this special indoor air pollutant in many countries: on the radon. The Word Health Organisation published a Handbook dedicated to radon in 2007. The estimated risk of inhalation of radon daughter products was multiplied by a factor of two submitted by the International Commission on Radiation Protection comparing to their former assessment.

The radon can only accumulate in indoor spaces by moderated ventilation condition, thus there is a contradiction between the requirements of energy saving reconstructions and the radiohygiene regulation. Within my presentation I would like to share some results regarding the level of indoor radon concentration in Hungarian homes, schools and kindergartens.

Indoor air quality in salt chambers

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Keywords: *indoor air, salt chamber, salt inhalation therapy, halotherapy*

Although the results of the available studies on the therapeutic effectivity of salt rooms are inconsistent, salt chambers are popular in Hungary. Besides commercial salt rooms, most of the kindergartens and elementary schools operate salt chambers. Several technologies are used: halogenerators spreading dry sodium chloride aerosols, nebulizers working with certain concentrations of sodium chloride solutions as well as small chambers with salt-brick walls without sodium chloride aerosolizers or nebulizers. There are no standards for operating these establishments, neither for the salt aerosol concentration nor for other parameters. As salt therapy is used for prevention or as complementary therapy for pulmonary diseases, it is expected from salt chambers to improve health status without any harmful effects.

To investigate whether the indoor environment of salt chambers used by children comply with indoor air quality guidelines; carbon dioxide, bacteria, fungi and sodium chloride aerosol concentrations were measured in several salt chambers during salt inhalation therapy.

The concentration of carbon dioxide, one of the indicators of ventilation, exceeded 1,500 ppm in most cases, the maximum values during salt inhalation therapy ranged between 1000 and 3,270 ppm. The concentrations of bacteria in the indoor air varied between 710 and 27,000 CFU m^{-3}. The concentration of sodium chloride in the air varied between 0.5 and 33 mg m^{-3} in rooms where sodium chloride aerosolizers/nebulizers were applied, while it was lower than 0.5 mg m^{-3} in chambers with only salt brick walls or pots filled with saturated salt solutions.

Many of these salt chambers are small rooms with inadequate ventilation and are used by too many children at the same time. In such circumstances the indoor air quality guidelines cannot be fulfilled. The therapeutical concentrations of salt aerosol suggested by the literature are between 5 and 16 mg m^{-3}. Exceeding the recommended value might pose a health hazard, while chambers having very low sodium chloride concentration could not be efficient.

The contribution of environmental toxicants to the development of autism spectrum disorder

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Keywords: *autism spectrum disorder, environmental, epigenetic, air pollutant*

Autism spectrum disorder (ASD) is one of the neurodevelopmental disorders known as pervasive developmental disorders. It is characterized by impaired communication and social interaction and restricted, repetitive and stereotyped patterns of behaviors, interests or activities. The expression of these characteristics in different people widely varies in range and severity. ASD is a multicausal disorder, caused by a combination of hereditary or de novo mutations as well as epigenetic changes due to several environmental factors which can modulate gene expression without changing the underlying DNA sequence. The mechanism by which these environmental factors are described to act: oxidative stress, inflammation, hypoxia, endocrine disruption, neurotransmitter and signaling pathway alterations. The prevalence is 1-1,5%, according to international databases.

The aim of our study was to investigate the prevalence of ASD in Hungary, and the association of ASD prevalence with some environmental factors occurring at the fetal or infant life, e.g., home in polluted area, presence of mold in house.

In the framework of the Hungarian Children's Respiratory Health Survey, besides respiratory diseases and symptoms, several other disorders were investigated in association with environmental factors. The questionnaire was sent to parents of 9-10-year-old schoolchildren. About 60,000 questionnaires were filled in and the first 10,329 originating from three counties were analyzed up to now.

The prevalence of ASD was 1,2% and it was more common in boys. *Significant association was found between ASD and prenatal and early age exposure to air pollution and presence of mold at home.*

Besides birth cohorts, cross-sectional studies investigating both perinatal and family anamnesis and the environmental conditions of the children can contribute to elucidating the etiology of some multicausal, neurodevelopmental disorders affected by several environmental factors.

Improvement of indoor air quality in classrooms by continuous air monitoring

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Keywords: *indoor air quality, monitoring, carbon dioxide, $PM_{2.5}$, schools*

A baseline analysis carried out on the indoor air quality (IAQ) in Polish primary schools within the framework of the InAirQ project indicated that low air exchange rate in the classrooms and a very low awareness of IAQ among the school staff are crucial problems. The thermo-modernization of the school buildings is one of the main reasons of the airtightness of the classrooms. On the other hand, the teachers do not open the windows frequently during the breaks. The poor ventilation is correlated with the increase of the CO_2 concentration in the indoor air, which might cause drowsiness, deficits of attention and decreased effectiveness. The uncontrolled ventilation of classrooms may cause increased $PM_{2.5}$ concentration in the indoor air, especially when the $PM_{2.5}$ concentration is high outdoors.

The use of air quality monitors in IAQ improvement was tested in a Polish primary school. The main goal of equipping some classrooms with IAQ monitors was to provide guidance on ventilation to the teachers and, as a consequence, to keep the concentration of CO_2 and $PM_{2.5}$ mass low.

The continuous monitoring of IAQ parameters was conducted for four weeks in four classrooms and outdoors. Two classrooms were used as control rooms without continuous monitoring. However, IAQ was investigated at all locations on the 1st and the 4th weeks. The IAQ data collected during schooltime (8:00 - 16:00) was used in the statistical analysis.

The results showed that the concentration of CO_2 significantly decreased in the classrooms where continuous air quality monitoring was conducted. The minimum and maximum CO_2 concentration values were 442 and 4121ppm for the first week and 405 ppm and 2510 ppm for the fourth week, respectively.

Urinary iodine concentration in schoolchildren in Hungary

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Keywords: human biomonitoring, urinary iodine, children

According to international evaluations, Hungary is considered to be a moderately iodine deficient area. Human biomonitoring surveys were carried out in the country between 1994 and 1998 and in the early 2000s to assess iodine intake. At that time, only 20% of the population lived in settlements where the drinking water iodide concentration was sufficient or high. The results of the goiter assessments carried out at this time showed that the prevalence of goiter in boys aged 7 to 11 years exceeded the 5% recommended by the WHO. Since then, the proportion of settlements with drinking water with sufficient or high iodine concentration has decreased from 20% to 3%, while the use of iodized salt has become obligatory in public catering. However, iodide measurements have since stopped, so there are no current data on the iodine supply of the population.

For this reason, the urinary iodine concentrations of 9-12-year-old children were measured within the framework of the InAirQ project that focuses on the investigation of the associations between the school environment and the health status of primary school children. The iodine content of urine was determined by spectrophotometric method based on the Sandell-Kolthoff reaction.

The iodine concentration was lower than 50 μg/L about 8% of the 263 urine samples collected in 16 primary schools, while extremely high values were measured in the samples collected in one settlement

Rapid improvement of the indoor air quality in schools by using a surface emissions trap for stopping spread of emissions into the indoor air

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Keywords: *VOC, emissions, adsorption, cTrap, IAQ*

School buildings are in focus as concerns indoor air quality (IAQ). Unsatisfactory IAQ may lead to suboptimal school performance, sick leave, headache, skin irritation, symptoms in the respiratory tract such as asthma etc. In many cases this problem is due to the spread of volatile organic compounds (VOC) from the materials of the building into the indoor air. This presentation describes the use of a surface emissions trap (cTrap) for stopping such emissions thereby avoiding the adverse health effects.
The cTrap is an innovation from Lund University Sweden. It is a four-layer adsorption cloth and is applied on surfaces indoors from where VOC emissions are being spread, thus on the floor, ceiling and/or walls. The emission molecules (all kinds of reaction/degradation products, VOC, odours etc) are stopped and bound in the cTrap by adsorption. There are no chemicals in the cTrap, and no chemicals are used upon installation. Because the adsorbent layer works together with a semipermeable polymer layer the adsorption is virtually irreversible. The cTrap cloth is air tight but has virtually no resistance for water vapour. Thus the moisture balance of the building will not change - there will never be any condensation of water on the cTrap cloth (which might lead to mould growth).
Emission molecules that pollute the indoor air may originate from treated wood/timber, asfa boards with PAH emissions, floor emissions e.g. of 2-ethylhexanol and other moisture driven emissions from concrete floor, odorous emissions from old linoleum mats etc. All of these emissions are efficiently stopped and bound by the cTrap leading to decrease or total elimination of symptoms. Occasionally, visible surface mould may be observed. In such cases, after the mould has been removed by chemical or mechanical methods, the surface is being covered by cTrap to ascertain that no remaining mould products, or traces of the aggressive chemicals that might have been used, can escape into the indoor air.

School children with allergy, MCS, or asthma, for example, may be particularly vulnerable to IAQ problems (which frequently are driven by moisture following water damage of the school building). In such cases, in order to prevent rapid worsening of their symptoms, it is vital that the IAQ in the school building is restored as soon as

possible. The cTrap is very useful in this respect being quick and easy to install (typically by using an adhesive tape on floors and a staple gun on walls/ceiling). An improved perceived IAQ can be noticed within minutes after installation. The cTrap is currently being used to improve the IAQ in schools in Scandinavia.

Health impact assessment of ambient air pollution in Hungary

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Keywords: *health impact assessment, ambient air pollution, AirQ+, GIS*

Air pollution represents the biggest health burden among the environmental factors in Hungary. It is important to have accurate information on the health risk of air pollution in order to provide reliable data to the public and to the decision makers.
Health impacts of ambient air pollution have been estimated in Hungary at two levels: at the local level based on the air quality data from the automatic background monitoring stations (2008-2016) and at the national level based on the EEA's interpolated air quality maps. In the latter case, population exposure has been defined for all Hungarian settlements by using GIS tools. Health impact assessment has been applied by the AirQ+ tool developed by the WHO Regional Office for Europe. Both short-term and long-term effects were estimated for pollutants $PM_{2.5}$, NO_2 and O_3. Selected results will be presented.
At the city level, 3-11% of the total natural mortality can be attributed to the $PM_{2.5}$ pollution (>10 μg/m^3 annual mean). In the biggest city (Budapest) this represents 1400-1660 excess deaths per year. 14-21% of the ischaemic heart disease mortality and 10-30% of stroke mortality can be attributed to the $PM_{2.5}$ pollution. The NO_2 annual mean exceeded the cut-off (20 μg/m^3) only in a few cities, 2.7% of the total mortality can be attributed to the maximum concentration. 2-6% of the respiratory mortality can be attributed to the ozone exceedances (SOMO35) in the summer periods.
At the national level we estimate 6347 (lower estimation: 4179; upper estimation: 8337) excess deaths per year due to the $PM_{2.5}$ pollution exceeding 10 μg/m^3 annual mean and 836 (396; 1275) excess deaths per year due to the NO_2 pollution exceeding 20 μg/m^3 annual mean in 2015. Due to the ozone exceedances 176 (64; 298) excess respiratory mortality cases can be estimated.

Sources, exposure and health risk to legacy and emerging Flame retardants in Spanish indoor environments. An integrated health RISK approach (FlameRISK).

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Keywords: *Flame retardants, indoor environments, monitoring, in-vitro toxicity, in-silico models*

Flame retardants (FRs) are a group of compounds that are added in consumer products to comply with flammability standards for household and industrial items. Common items that have contained FRs include furniture foam and plastics used in electronic equipment such as computers, monitors, and TVs. The type of FRs used depends on material compatibility, costs, and the flammability standard. The general objective of FlameRISK is to understand how and to what extent FRs are released from consumer products in Spanish indoor environments and to assess the human exposure and the associated health risks. The project will be focused not only on restricted FRs but also on the new emerging such as organophosphate flame retardants (OPFRs). In-silico tools (such as PBPK/PD and QSAR) and emerging non-animal techniques (such as in vitro-targeted strategies and system toxicology) will be used to understand the neurotoxicity mechanisms of FRs. Results of FlameRisk will provide insights into the precise nature and scale of the presence of FRs in indoor environments and the human health risk. This information can help for the development of strategies to minimise future contaminant releases as well as to address and legislate against the environmental and human health risks associated with existing contamination. FlameRisk will develop methodologies that can be of great asset for scientists working to understand the health risks of other organic chemicals to human and wildlife through inhalation and dermal exposure. The methodology and tools developed in this project may also be applicable in other pharmacological studies (both environmental toxicants and drugs).

Characterization and dosimetry-assisted risk assessment of size segregated indoor particulate matter ($PM_{10-2.5}$, $PM_{2.5-0.25}$, and $PM_{0.25}$) collected in different schools.

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Keywords: *coarse PM, quasi-ultrafine PM, indoor, main components, children health risk assessment*

Aerosols, or particulate matter (PM) are considered the most harmful air pollutant, responsible of more than 7 million premature annual deaths worldwide, according to WHO. Present works aims to increase the current knowledge regarding composition and risks of indoor PM in schools located under the influence of different aerosol sources. To accomplish that, coarse, accumulation mode, and quasi-ultrafine PM ($PM_{10-2.5}$, $PM_{2.5-0.25}$, and $PM_{0.25}$, respectively) were collected inside classrooms of twelve schools located in urban, suburban, and industrial areas of Tarragona County (Catalonia, Spain) during two seasons (cold and warm). An analysis of metals, soluble inorganic ions, and total carbon was subsequently performed with the collected particles. Finally, a health risk assessment was conducted to calculate children's exposure and to assess the health risks associated to the inorganic components of PM. In most schools, PM levels were below the daily PM_{10} threshold established in the regulation (50 $\mu g/m^3$), with the exception of school number 1 during the cold season. On average, and regardless of season, coarse PM was highly influenced by mineral matter, while organic matter and elemental carbon were prevalent in quasi-ultrafine PM. The concentrations of the toxic elements considered by the legislation (As, Cd, Pb, and Ni) were below their correspondent regulatory annual limits. Calculated risks were below the safety thresholds, being fine fractions ($PM_{2.5-0.25}$ and $PM_{0.25}$) the main contributors to both digestive and respiratory risks.

Evaluating the health risk of indoor air pollutants in Central European primary schools

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Keywords: *air pollution, health risk, indoor air, maximum cumulative ratio*

Children aged 6-14 spend approximately 6-9 h in school buildings on a weekday in Central Europe, thus there is still an increasing concern about indoor air quality (IAQ) in these microenvironments. In order to develop action plans to improve IAQ in schools, it is necessary to investigate the health risk associated with indoor air pollutants.

The air quality was monitored in 64 primary school buildings in 2017/2018. In each school, the air quality was investigated in one classroom and outdoors from Monday to Friday. The excess lifetime cancer risk (ELCR) was estimated by the product of the inhalation unit risk and the exposure concentration. Hazardous quotient (HQ) was calculated to evaluate the non-carcinogenic risk for each compound. The health risk associated with the co-exposure to multiple air pollutants was assessed by the hazard index (HI). The maximum cumulative ratio (MCR) approach was also applied to determine whether one or more compounds are responsible for the health risk.

The calculated sum of the ELCR values was higher than 10^{-6} in the case of several primary schools which means that a certain portion of the Central European pupils are exposed to unacceptable risk. The mostly affected schools are in Hungary, Italy and Slovenia. Neither the HQ nor the HI values exceeded one (with one exception for HI) which means that the non-carcinogenic risk associated with the investigated air pollutants might not cause adverse health effects during the time when the schoolchildren are in the school building. The MRC values were mostly between 2 or 3, which means that, in general, only a couple of compounds with high HQ values are relevant for the human health.

Attempt for indoor air quality improvement in a primary school by an air cleaner

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Keywords: *air pollution, indoor air, intervention, air cleaner*

The quality of the air inside school buildings is an essential determinant of the health, comfort and well-being of schoolchildren. InAirQ is an international project aiming to investigate indoor air quality (IAQ) and to take actions to improve the indoor environment in the school buildings in Central Europe. To sum up our findings on the IAQ measurements, it can be stated that in general the major IAQ-related problems were the low relative humidity values as well as the high carbon dioxide and $PM_{2.5}$ mass concentration values in Hungary.
Although source control is the preferred way to reduce the concentration of pollutants, this is sometimes technically unfeasible, insufficient or economically unviable. Laboratory tests demonstrate that air cleaners produce clear reductions in the concentration of pollutants.
Two classrooms (intervention and control rooms) in one primary school building were selected for the study conducted for three weeks to test the efficiency of an air cleaner in the school environment. Several IAQ parameters were investigated on the first and the third weeks in the classrooms and outdoors. An air cleaner usually used at homes was placed in one of the classrooms on the second week and was used until the end of the study.
The relative humidity increased in the intervention room when the air cleaner was used compared to the results obtained for the control room. The $PM_{2.5}$ mass concentration values were high in both classrooms during the study; however, lower $PM_{2.5}$ mass concentration values were obtained when the air cleaning device was used. It must be noted that the concentration of fine particles was still higher indoors, especially during the breaks, than outdoors, which indicates that the applied air cleaner is not efficient enough to quickly remove the particles either originating from the re-suspension of settled dust or caused by the inappropriate ventilation. However, it is clear that the use of appropriate air cleaners improves IAQ. It is recommended to use air cleaners with high clean air delivery rate in the classrooms.

Determination of primary aromatic amines from saliva for testing their migration from dyed toys and writing utensils

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Keywords: *primary aromatic amines, sample preparation, saliva*

The group of primary aromatic amines (PAAs) has numerous carcinogenic compounds. PAAs can be released from azo dyes due to hydrolysis or reduction. The risk of exposure is higher in case of products that can come into direct contact with skin or oral cavity. Therefore, dyed toys and writing utensils may pose a risk for the health of infants and schoolchildren. Any product that is designed to be used by children below 14 falls into the scope of the 2009/48/EC Toy Safety Directive. The mouthing actions of infants below 3 are obvious but mouthing pencils is still common among schoolchildren.

Based on the EN 71 standard series PAA migration should be tested by a simple water extraction procedure. The extraction efficiency of water compared to saliva is highly questionable. Thus, we developed a simple extraction method from saliva for the determination of 9 PAAs listed in the EN 71-9:2005+A1:2007 standard. We alkalified and salted out saliva with sodium hydroxide and sodium citrate during extraction with acetonitrile. The method includes repeated centrifugation and homogenization as the protein precipitate formed during the extraction has to be smashed by vigorous shaking to avoid loss of target compounds. The supernatant was diluted with water and alkalified with ammonia prior LC-MS/MS analysis.

We confirmed the linearity, accuracy, precision and robustness of the method in the range of 5-75 ng/mL with the analysis of fortified individual and pooled saliva samples. Accuracy values were between 91-116% with a precision of 1-7% (n=3).

These values prove that the developed method can be used for further migration testing of PAAs from dyed toys and pencils. We intend to investigate and compare the extraction efficiency of saliva and water and - if needed - suggest a more realistic model solution for migration testing.

Assessment of risks of combined exposure to hazardous chemicals in indoor air in public settings for children
WHO Europe side-event
24 May 2019, 13:30 – 16:30

Introduction

The need for assessment of real-life exposure to chemicals and the associated health risks is growing, since the common chemical-by-chemical approach most probably leads to underestimation of risks. To support implementation of assessment of combined exposure and related risks for human health, WHO has developed a framework, which allows for a "*fit for purpose*" assessment, to ensure that no more resources are invested in risk assessment than *'necessary to make a decision for the purpose at hand*". At the "*Multiple exposure and risks: evidence review, knowledge transfers and policy implication training workshop*", held in October 2013 in Bonn, Germany, an assessment of risk of combined exposure to chemicals has been identified as a priority issue for the WHO European Member States. As a follow up, the WHO Europe has undertaken an initiative to develop a tool for assessment of risks of combined exposure to chemicals in indoor air of public settings for children. The methodological approach and the current status of the development of the tool will be discussed at the side-event.

Description

This side-event will introduce a methodological approach to the development of a tool for assessment of risks from combined exposure to hazardous chemicals in indoor air in public settings for children, and to pilot test assessment of risks from combined exposure. The scientific aspects of the tool and the approach to collecting of toxicological information will be covered in the presentations by the public health experts from the National Public Health Institute, Hungary and the WHO European Centre for Environment and Health.
The following topics will be covered:

- The evidence of the negative health impacts of hazardous chemicals in indoor air on children's health;
- The WHO Framework for assessment of risks of combined exposure to multiple chemicals and its application for the tool;
- The status of the collection of toxicological data and information for exposure assessment needed for the tool.

During the second part of the event, participants will have an opportunity to take part in the hands-on exercise, and to perform a risk assessment of combined exposure to multiple hazardous chemicals in indoor air, starting from the selection of a school of interest, until the calculation of risk of adverse effects of children's respiratory system. Participants will be invited to share their opinion about the applicability of the tool for evaluation of a quality of a school indoor environment and the development and implementation of risk reduction measures as well as on a questionnaire for prioritization of sampling sites, and to express their views on the needs for capacity building to facilitate uptake of the tool at a national level. The discussion during the event and opinions of the participants will inform further steps towards the completion of the tool.