

THE EFA PROJECT: INDOOR AIR QUALITY IN EUROPEAN SCHOOLS

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ABSTRACT

The objectives of the EFA project 'Indoor Air Pollution in Schools' were to collect information on indoor air quality (IAQ) in European schools, to review the related policies and preventive programs and to formulate recommendations aimed at providing a healthy school environment. IAQ in schools should be recognized as a priority topic for public health. School buildings are used by a large number of people for a long time but its IAQ has been much less studied than in other buildings. Schools frequently have serious indoor problems because of poor building construction, maintenance, cleaning and ventilation; high levels of VOCs and allergens are reported. The IAQ in schools can cause various short- and long-term negative health effects and discomfort, particularly in subjects with allergy. Nowadays only a very few European countries have guidelines aimed at improving IAQ. A multidisciplinary European program aimed at improving the IAQ in schools is needed.

INDEX TERMS

Schools, air pollutants, allergies and asthma, policy.

INTRODUCTION

The European Federation of Asthma and Allergy Associations (EFA) is a patients' network representing 250,000 individuals who are members of 33 associations in 17 European countries. The aim of this Federation is to improve the health conditions and quality of life of people with asthma and allergy throughout Europe. In 1995 an EFA study clearly illustrated the need for investigations about the impact of environmental factors on the health conditions of people with asthma and allergy (EFA, 1997). It was in this light that EFA received a grant from the European Commission, DG SANCO, for the project 'Indoor Air Pollution in Schools'. This project focussed on indoor air quality (IAQ) and its health effects (primarily asthma and allergy) in nursery, primary, and secondary schools in Europe. The objectives of this project were: to collect information on IAQ in European schools; to review policies and preventive programs of European countries in this field; to formulate recommendations aimed at providing a healthy school environment.

METHODS

Information on IAQ, ventilation, and building-related health problems in schools was collected, and critically reviewed and analyzed. Scientific publications were identified through computer searches of bibliographic databases. The keywords used were: air conditioning, air pollution, air pollutants, airway infections, allergens, allergy, asthma, children, environmental exposure, environmental health, exposure assessment, heating, hyper-reactivity, indoor air quality, microclimate, nurseries, respiratory health, risk assessment, school building, school children, schools, ventilation, young adults. Only papers published since 1990 have been considered. The Proceedings of the most important IAQ congresses (the

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Indoor Air and Healthy Buildings series) were also consulted. The Internet was scanned for relevant documents, initiatives, policies and programs aimed at providing a healthy school environment were collected.

A questionnaire was designed to collect information about reports, research programs and policies on IAQ in schools, and on initiatives aimed at providing a healthy school environment. The questionnaire was distributed in European countries through the EFA member associations' network. Data came also from scientific societies such as the European Academy of Allergy and Clinical Immunology (EAACI), the European Respiratory Society (ERS), the European Society of Paediatric Allergy and Clinical Immunology (ESPACI) and the International Society of Indoor Air Quality and Climate (ISIAQ).

A database was developed to store the information obtained.

A general consensus on recommendations and practical initiatives in relation to indoor air pollution in schools to present to the European Commission and national governments was approved by the EFA board, the project Scientific Committee and the EFA project partners.

RESULTS

Dimension of the problem

During the 1996/97 academic year there were slightly more than 71 million students (<18 years) in the European Union, representing about 19% of the total population. In most countries children attend school five or six days a week, for over 800 hours a year (EC, 2000). The number of teachers working in the primary and secondary schools during the 1996/97 academic year was nearly 4.5 million. The teaching profession constitutes 3% of the total working population in the EU (EC, 2000).

Main outcomes of the literature search

We found 73 papers published since 1990 concerning IAQ in schools from 11 European countries (Figure 1).

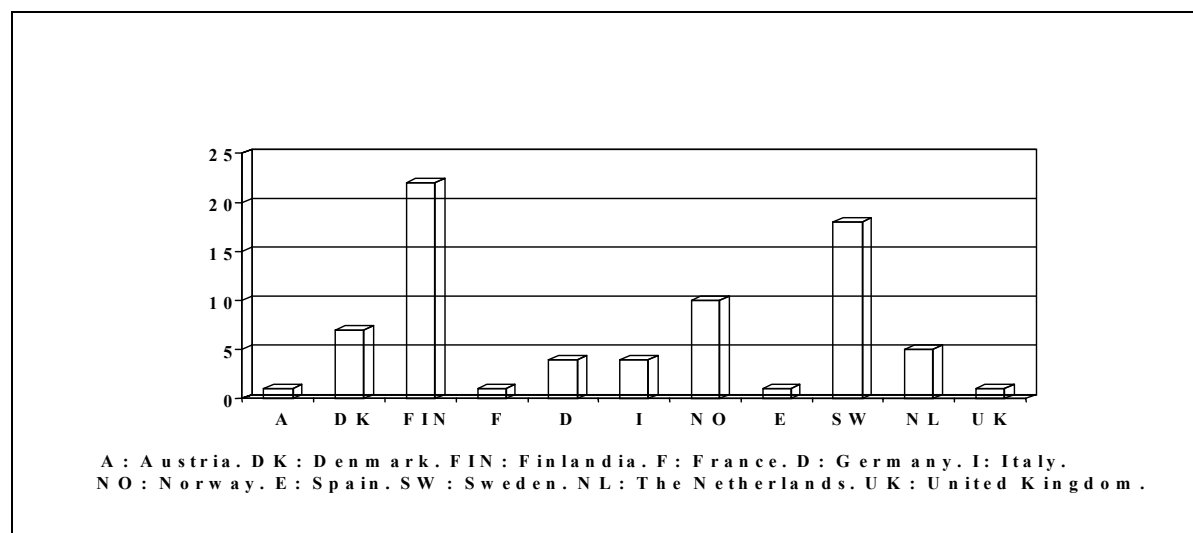


Figure 1. Papers concerning indoor air quality in European schools published since 1990.

A. School building characteristics and related health effects

Ventilation and CO₂

Poor ventilation rate, air exchanges and airflow inside schools causing increasing CO₂ levels in classrooms, are common throughout Europe. Poor ventilation was found to be related to current asthma, mucosal irritation, dizziness, dry or irritated throat, irritated or itchy eyes, headache, hoarseness or pain in throat, runny nose and dry, irritated or stuffy nose (Smedje, 1997b). It has been shown that renovation of schools to obtain a good ventilation rate induced a significant reduction in general symptoms; an appropriate ventilation rate also seemed to reduce airborne concentrations of cat allergens (Smedje, 2000).

Moisture-damaged construction material and the presence of microbes.

High humidity inside buildings due to water-damaged construction material is frequently related to the presence of mould allergens, fungi and bacteria. The presence of humidity-related fungi is related to the prevalence of respiratory symptoms (Taskinen, 1999).

B. Air pollution measured in schools and related health effects

Particulate matter

The concentrations of particulate matter (PM) are often higher in schools than in adult work environments (Janssen, 1997). The elevated classroom concentration of PM is related to the material brought in on the children's shoes, the use of chalk to write on the blackboard and to a higher indoor physical activity of the children. Indoor PM concentration was found to be related to the prevalence of nose symptoms (Carrer, 1994).

Volatile organic compounds and formaldehyde exposure

Volatile organic compounds (VOCs) and formaldehyde are emitted from the ceilings of schools and from furniture made from industrially produced hardboard or paneled materials. Also paint and cleaning products are potential VOCs emitters. VOC exposure is related to the prevalence of Sick Building Syndrome (SBS), rhinitis, cough and burning eyes; after removal of VOC-emitting sources many complaints are reduced (Norbäck, 1990; Norbäck 2000).

Environmental tobacco smoke

No studies about the importance of passive smoking at school were identified.

Dust related to mite exposure

In nursery schools textile materials such as mattresses, pillows, curtains, (wall-to-wall) carpets, open shelves etc, are frequently used to create a pleasant or effective ambience for the children. These materials have been shown to act as a reservoir for dust mites (Einarsson, 1995). Dust exposure is related to an increase of asthma attacks in mite-allergic children and occurrence of SBS (Smedje, 1997b). Dust samples from classrooms where the routine cleaning procedure was a combination of dry and wet cleaning contained significantly lower levels of mite allergens than those from classrooms where the cleaning procedures were mostly either dry or wet (Wickman, 1999).

Pet allergens

School is an exposure risk environment for cat- and/or dog allergic children (Almqvist, 1999). The levels of cat and dog allergens (Fel d1, Can f1) are related to the children who have a cat and/or dog at home and who transport allergens on their hairs, clothes, shoes and bags to school. Keeping pets seems to reduce children's exposure to pet-allergen in schools (Berge, 1996). Textiles have been shown to act as a reservoir for these allergens. School classrooms with carpeted floors accumulate more dust, protein and allergens per unit area than smooth

floors (Dybendal, 1991). The airborne levels of allergens vary depending on the activity in the classroom. Exposure to cat and dog allergens increases symptoms and allergic inflammation in children who are sensitized to cat and/or dog allergens (Almqvist, 1999; Munir, 1993).

C. Survey of International and National programs on indoor air quality in schools

Only in a very few EU countries are there laws, directives and guidelines aimed at improving the quality of indoor air in schools.

DISCUSSION

Indoor air pollutants can be particularly harmful for pupils and students with allergy, asthma or airway hyper-reactivity. Measures taken to counteract this risk could help to arrest the increase in asthma and allergy, and reduce the negative effects on the children's health. Basic requirements for good IAQ in schools should include (Rådö, 2001): avoidance of environmental tobacco smoke; avoidance of moisture/moulds in the building; avoidance of allergen sources; adequate cleaning and maintenance, practical shaping of the interior to facilitate cleaning and maintenance; good control of the maintenance of heating and ventilation to ensure a satisfactory temperature and ventilation in the classroom; adequate periodical monitoring of the IAQ parameters in schools; appropriate training of students, teachers and school staff who are responsible for management, maintenance and cleaning.

The school environment is compulsory; children cannot make decisions concerning their own (school) environment because they are placed at a school and did not choose it themselves. This should put an obligation on school authorities to provide an environment that is appropriate also for children with allergy or other kinds of hypersensitivity. Schools should be adapted towards the benefit of asthmatic and/or allergic children. The European Union, national authorities, scientific societies and all organizations implicated in this topic can play an important role in producing a multidisciplinary European program aimed at improving indoor air quality in schools. The objectives should be to:

- Promote initiatives, including legislative initiatives, to regulate school buildings in terms of design, construction, materials used (e.g. carpets and other textile materials), ventilation, safety, cleaning and building maintenance procedures, as well as tobacco smoking and allergen avoidance.
- Obtain regulations to ensure a safe and healthy environment and generalized health control of schoolchildren in Europe.
- Improve existing regulations and implement their control.
- Promote awareness campaigns aimed at children and their families, school staff, policy decision makers, health professionals and the public.
- Promote training of students, teachers and other staff working in schools, which is a prerequisite for the success of the program.
- Promote research to develop sustainable measures aimed at improving IAQ in school-buildings.

Research is particularly required in the following areas:

- Implementation of epidemiological methodology. Standard questionnaires, medical visits and objective tests should be used to establish a system of medical surveillance and screening of schoolchildren. This system should yield prevalence, incidence and remission rates of symptoms/diseases which might provide important information to the environmental measurements taken to ensure good air quality in schools. An appropriate sample survey should identify the main specific IAQ problems and gaps, and evaluate the impact of poor air quality on the health of the overall population.

- Making a representative IAQ audit in European schools using the principal measurements of IAQ in combination with an evaluation of building characteristics and building use.
- Studies of the impact of the IAQ in schools on health and its effects on learning and life style of children.
- Studies of tobacco smoke exposure at school and its health effects.
- Studies to develop specific IAQ standards and guidelines for schools, including the optimal cost-effective ventilation level with respect to health, productivity, learning and use of energy.
- Studies to develop building operation, maintenance and IAQ monitoring program for schools.

Professional organizations and patients' associations play a very important role within this European strategy. They must increase public awareness, inform, educate and help both the public and those affected by asthma, allergy and hypersensitivity, and bring pressure to bear on their governments to take and encourage more coordinated action at national level. In the absence of national projects, the larger patients' associations have developed their own plans and actions and those with significant resources also make important contributions to professional training and research. The main actions taken by patients and professional organizations have been to improve public awareness and knowledge of this topic, to provide patients with support, education and practical assistance, to provide training and guidance for the various professions involved and to support research and surveys. The actions are implemented through publications and use of the media, telephone helplines, exhibitions, training courses and conferences, on the basis of a close collaboration with employers and education authorities.

CONCLUSIONS

Indoor air quality in schools should be recognized as a priority topic for public health:

- School buildings are used by a large number of people for a long time.
- Indoor air quality in schools has been much less studied than IAQ in other buildings (e.g. offices, and other working places). Scarce attention has been given to IAQ in these buildings, the related health effects, and the effectiveness of remedial measures.
- Schools frequently have serious indoor problems because of poor building construction, maintenance, cleaning and ventilation; in addition, high levels of VOCs, allergens and moulds (humidity) are a frequent finding.
- The IAQ in schools can cause various short- and long-term negative health effects and discomfort in students, teachers and other school staff.
- Indoor air pollutants can be particularly harmful for pupils and students with allergy, asthma or airway hyper-reactivity. Measures taken to counteract this risk could reduce the negative effects on the children's health.
- Few European countries have implemented laws, directives and guidelines aimed at improving IAQ in schools.

In the light of these considerations, EFA considers that the EU, national authorities, scientific societies and all organizations directly or indirectly involved in this topic can play an important role in producing and implementing a multidisciplinary European program aimed at improving the IAQ in schools. The right to breathe clean air in schools should be recognized as a fundamental health right at all levels. No child should risk becoming ill or having exacerbation of symptoms because of the air quality in the school environment.

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