Ministero
della Salute

GARD Italy
UN MONDO DOVE RESPIRARE LIBERAMENTE

Workshop

La qualità dell'aria indoor nelle scuole: rischi per malattie respiratorie e allergiche
Quadro conoscitivo della situazione italiana e strategie di prevenzione

15 Dicembre 2011, ore 10.00
Via Ribotta 5, Roma
Sala Auditorium

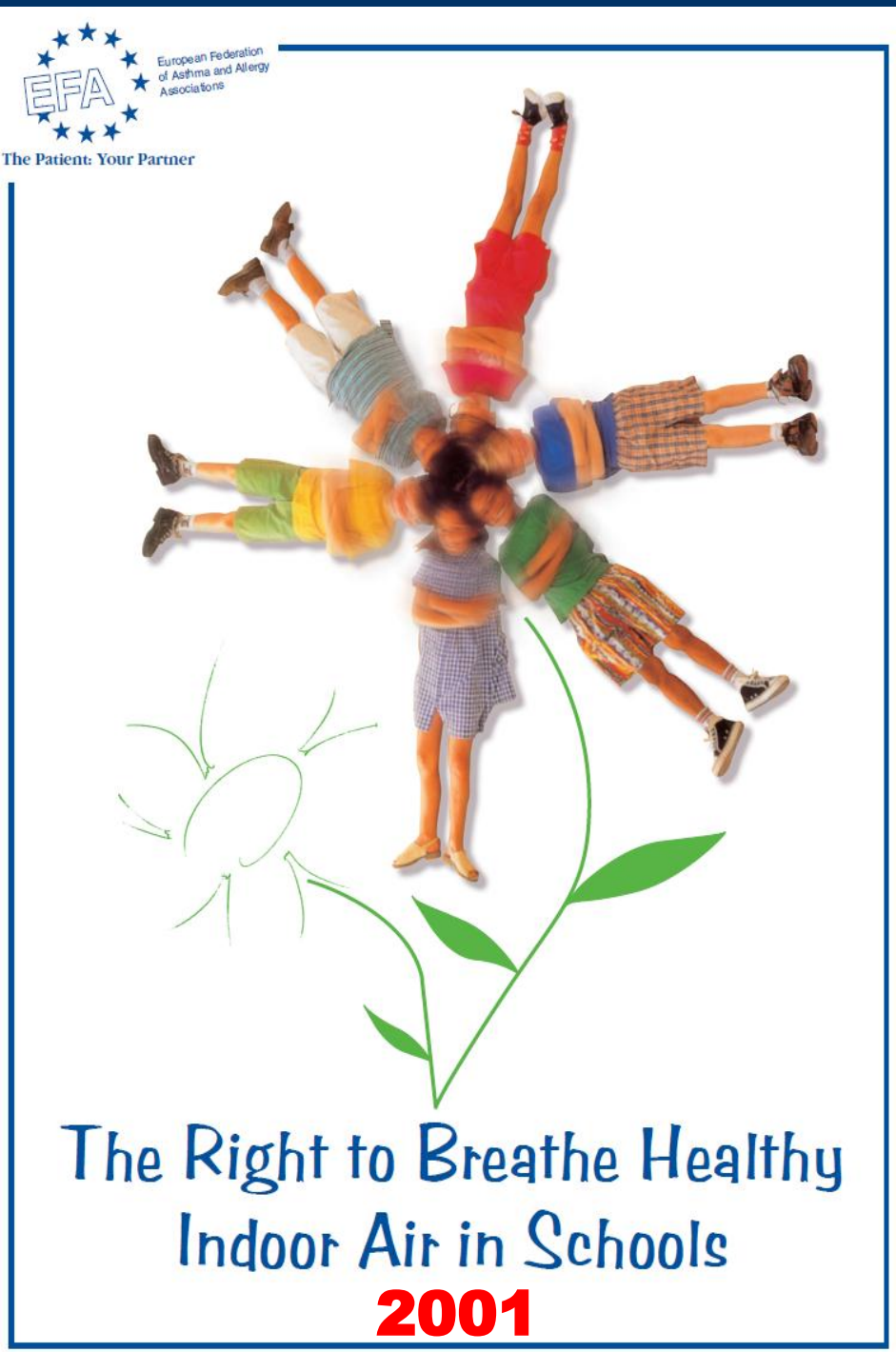
PROGRAMMA

Ore 10.00	**Registrazione**
Ore 10.30	**Apertura dei lavori** Ministero della Salute GARD Italia **Moderatori**: dr. G. Marano/G. Cavagni
Ore 10.45	**La IAQ nelle scuole: La cornice istituzionale di riferimento** A. de Martino
Ore 11.00	**Situazione dell'igiene edilizia ed ambientale nelle strutture scolastiche dell'infanzia e dell'obbligo in Italia** A. Baglioni/ U. Moscato
Ore 11.15	**Analisi delle evidenze epidemiologiche sui fattori di rischio indoor per malattie respiratorie e allergiche nelle strutture scolastiche** G. Viegi/S. La Grutta
Ore 11.30	**La IAQ nelle scuole: le iniziative in ambito Europeo** D. Kotzias
Ore 11.45	**Verso una strategia integrata di governance dell'indoor: considerazioni e buone pratiche** L. Sinisi/ F. De Maio
Ore 12.00	**Tavola rotonda: Le esperienze italiane** **Moderatori** : D. Kotzias /G. Viegi C. Pini, P. Carrer, P. Sestini, E. Colajacomo, F. Cibella, S. Fuselli, G. Settimo S. Frateiacci
Ore 13.00 Ore 14.00	**Discussione/** **Conclusione**

Analisi delle evidenze epidemiologiche sui fattori di rischio indoor per malattie respiratorie e allergiche nelle strutture scolastiche

Stefania La Grutta
Fabio Cibella
Giovanni Viegi

ARPA



EFA's Project on 'Indoor Air Pollution in Schools'

More than 1 of every 3 children in Europe has asthma or allergy. These diseases are the major causes of days lost from school and their socio-economic costs cannot be overestimated. Children are in school for one-third of their normal day.

Various studies have shown that poor indoor air quality (IAQ) in schools interferes with learning activities and can cause discomfort, irritation, and various short- and long-term health problems in students, teachers and staff. Indoor pollutants can be particularly harmful for students already affected by allergies or asthma.

In this scenario, it is crucial that people working in schools and the relevant authorities are aware of the problem of indoor air pollution.

The 'Indoor Air Pollution in Schools' project was undertaken in an attempt to assess the magnitude of the problem and to provide recommendations for a healthy school environment.

Franchi M, Carrer P.

Monaldi Arch Chest Dis 2002; 57: 2, 120–122

The magnitude of the problem

School buildings are used by a large number of people for a long time of their day. There are slightly more than 71 million students and nearly 4.5 million teachers in the primary and secondary schools in the EU, representing more than 20% of the total population. In half of the European countries, children spend over 800 hours a year in class, that is about one-third of their typical day. No child should risk becoming ill or having exacerbation of symptoms because of the air quality in the school environment.

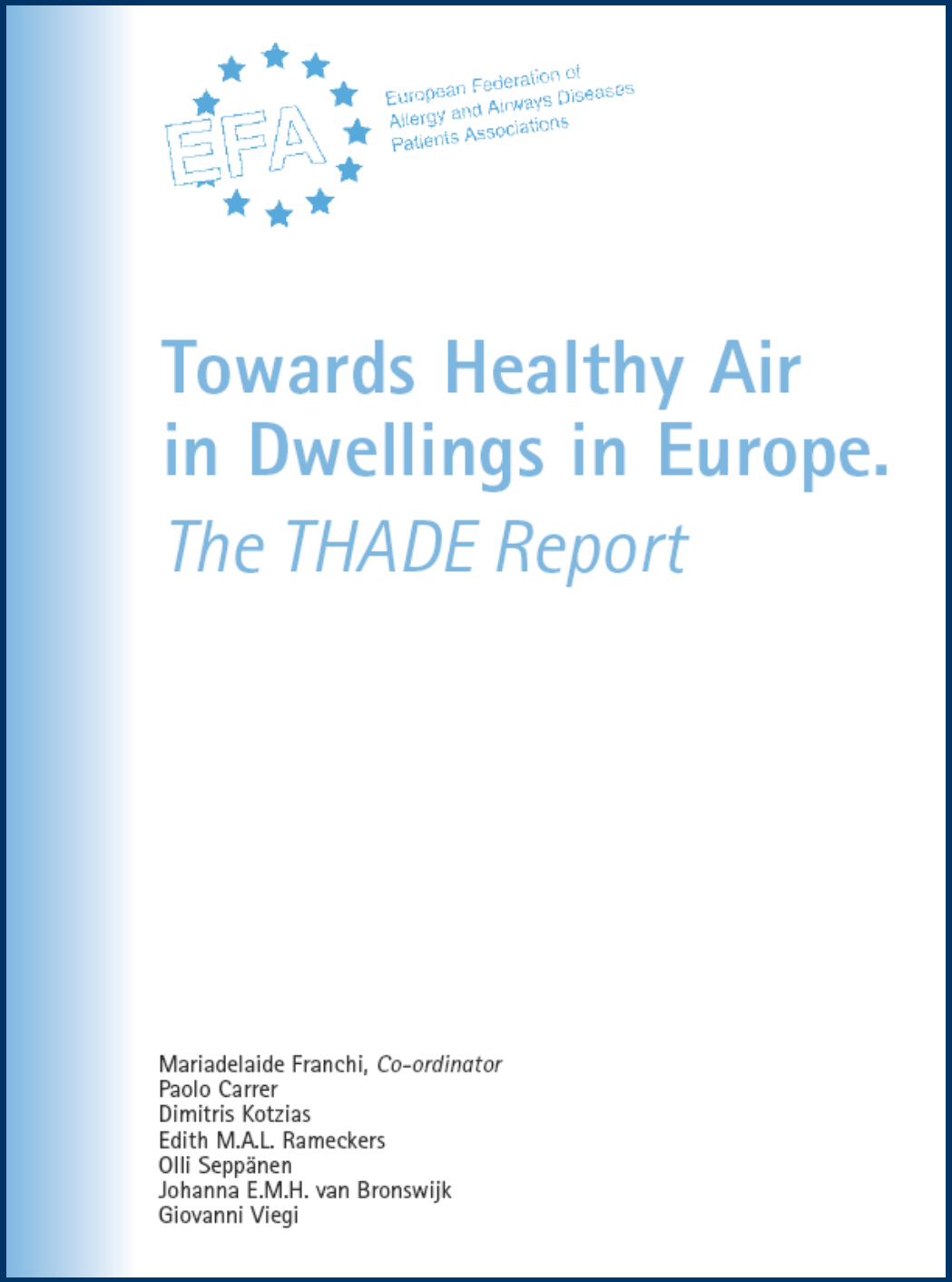
Recommendations for a European Programme on Indoor Air Quality in Schools

The right to breathe healthy indoor air in schools

The right to breathe clean air in schools should be recognised as a fundamental health right at all levels: by the European Commission, the Health, Environment and Education authorities in the Member States, and the scientific societies and professional organisations involved in this topic, and also by school staff, students, and the public at large.

European Programme on Indoor Air Quality in schools

There is a need for a multidisciplinary European Programme on Indoor Air Quality, with the emphasis on schools, that aims at encouraging and co-ordinating actions in the fields of research, legislation, prevention, education, information, and training. The main objectives of the Programme in the specific sector of schools should be to obtain regulations to ensure a safe and healthy environment and generalised health control of schoolchildren in Europe, and to promote awareness campaigns aimed at children and their families, school staff, policy decision makers, health professionals and the public.



- Project promoted by EFA

- Financial support from the European Commission (DG Sanco)

Franchi M, Carrer P, Kotzias D, Rameckers EM, Seppänen O, van Bronswijk JE, Viegi G, Gilder JA, Valovirta E.

Working towards healthy air in dwellings in Europe.

Allergy, 2006 61(7): 864-868

Actions at European level

The measures (included new directives and European standards) that could be taken at EU-level are:

- Actions to prohibit smoking in public buildings and the workplace.
- Campaign against smoking at homes.
- Better building codes for the new constructions especially as regards ventilation and moisture control.
- Measures to improve the indoor environment in the existing building stock.
- Develop testing and labelling procedures for air cleaners.
- Restrict pet exhibitions in public places (schools etc.).
- Develop product control and labelling systems for building materials, furniture and household products as regards harmful emissions:
  - Develop performance criteria for vacuum cleaners.
  - Develop testing methods for fibre release from mineral wools.
  - Develop inspection methods and control of small heating appliances.
- Promote research on indoor air quality in dwellings health effects and prevention.

Asthma and allergy and IAQ

(Jan Sundell)

Allergic diseases are supposed to be caused by a complex interaction between genetic and environmental exposures.

Key indoor exposure agents for sensitization and/or symptoms:

- **Microbial agents**
  - **house dust mite *(OR 4.8)***
  - **pet allergens**
  - **dampness *(OR from 1.4 to 2.2)*, mold *(OR 1.55-2.27 p<0.05; Cladosporium in house dust***
- **Chemicals**
  - **formaldehyde,**
  - **VOCs, phatalates, PVC flooring in child bedroom, cleaning products, indoor chemistry products**
- **ETS, Combustion particles**
  (*exposure to wood/oil smoke, soot, exhaust OR 1.74 p<0.05*)

2007

The EnVIE Concept from health impacts to policies

Sept.24.2007

2. Exposures

1. Health impacts

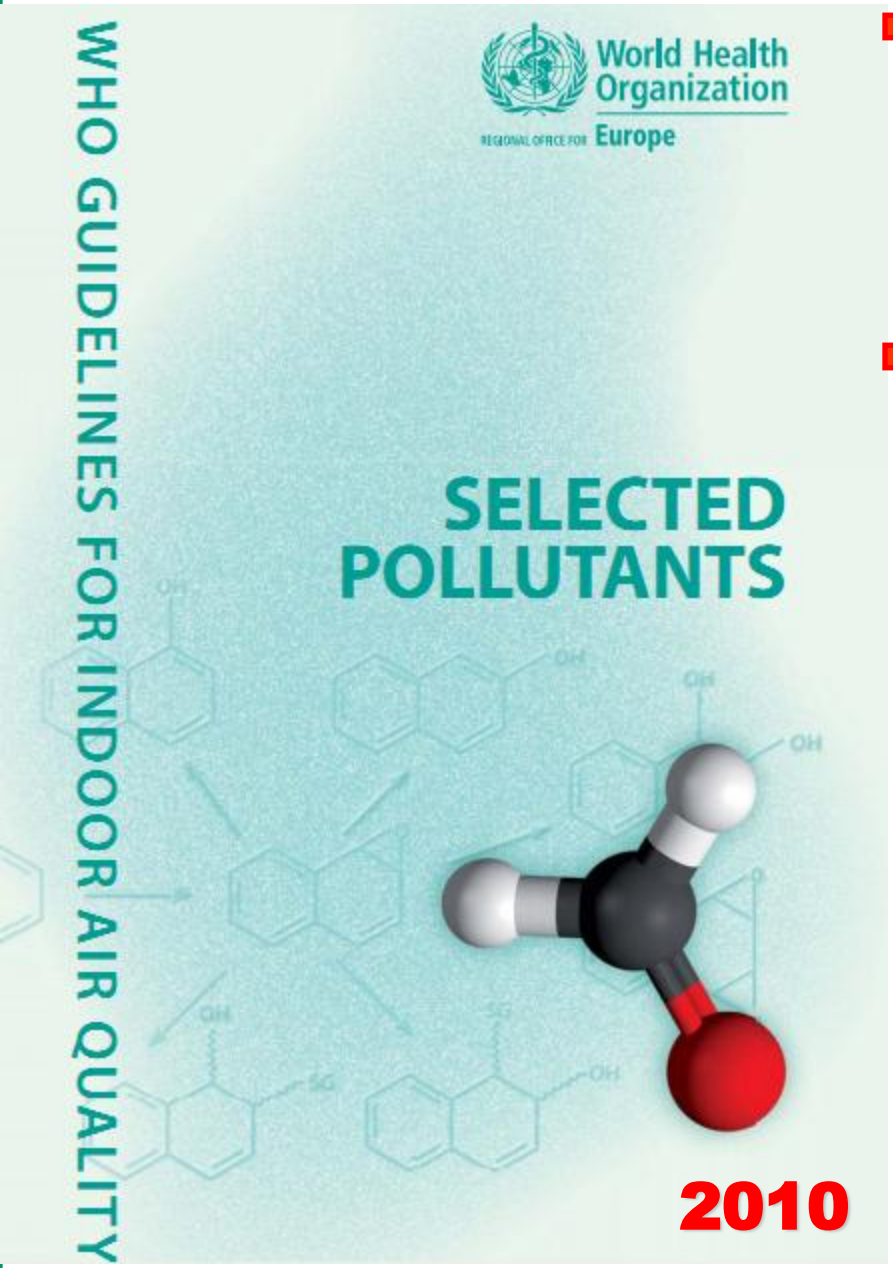
Allergy & asthma symptoms
Lung cancer
Obstructive pulmonary lung disease
Airborne respiratory infections
Cardiac morbidity and mortality
Sick building syndrome, irritation

3. Sources

Outdoor air
Building/Equipment/Ventilation
Consumer products
Occupant behaviour & maintenance

4. Policies

	Tobacco	Combustion particles	CO	Radon	Moisture, molds, dust mites	(S)VOCs
Health impacts	•	•			•	•
	•	•		•		
	•	•			•	
	•	•			•	
	•	•	•			
	•	•			•	•
Sources		•	•		•	•
	•	•	•	•	•	•
		•				•
	•	•	•	•	•	•



To provide a uniform basis for the protection of public health from adverse effects of indoor exposure to air pollution.

To eliminate or reduce to a minimum exposure to those pollutants that are known or are likely to be hazardous.

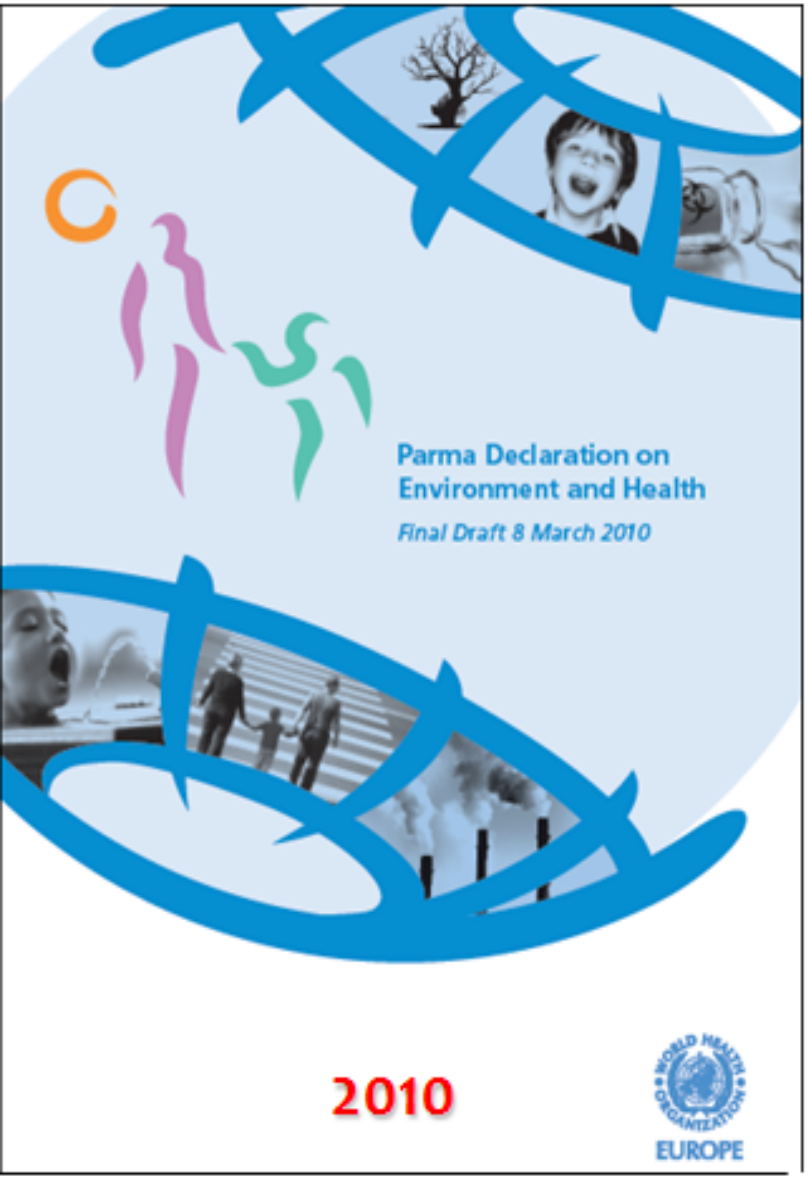
Benzene
Carbon monoxide
Formaldehyde
Naphthalene
Nitrogen dioxide
Polycyclic aromatic hydrocarbons
Radon
Trichloroethylene
Tetrachloroethylene

AMBIENTE E SALUTE Quinta conferenza ministeriale

PARMA 2010

Fifth Ministerial Conference on Environment and Health
Parma, Italy, 10-12 March 2010

Protecting children's health in a changing environment



A. Protecting children's health

RPG1-Ensuring public health by improving access to safe water and sanitation.

RPG2-Addressing obesity and injuries through safe environments, physical activity and healthy diet.

RPG3-Preventing disease through improved outdoor and indoor air quality.

RPG4-Preventing disease arising from chemical, biological and physical environments.

B. Protecting health and the environment from climate change.

C. Involvement of children, young people and other stakeholders.

D. Knowledge and tools for policy-making and implementation.

CONSILIUM – Highlights

04/12/11 10:49

PARTICIPANTS from Italy:

Mr Renato BALDUZZI

Minister for Health

Ms Elsa FORNERO

Minister for Labour and Welfare

MEETING ON 1 AND 2 DECEMBER 2011

Highlights

Efforts to protect children against respiratory diseases

Draft Council conclusions on "Prevention, early diagnosis and treatment of chronic respiratory diseases in children"

- *Adoption of Council conclusions*

INVITES the Member States and the Commission to:

improve the quality of indoor and outdoor environment in which children live and encourage them to be physically active

The Global **Asthma** Report 2011

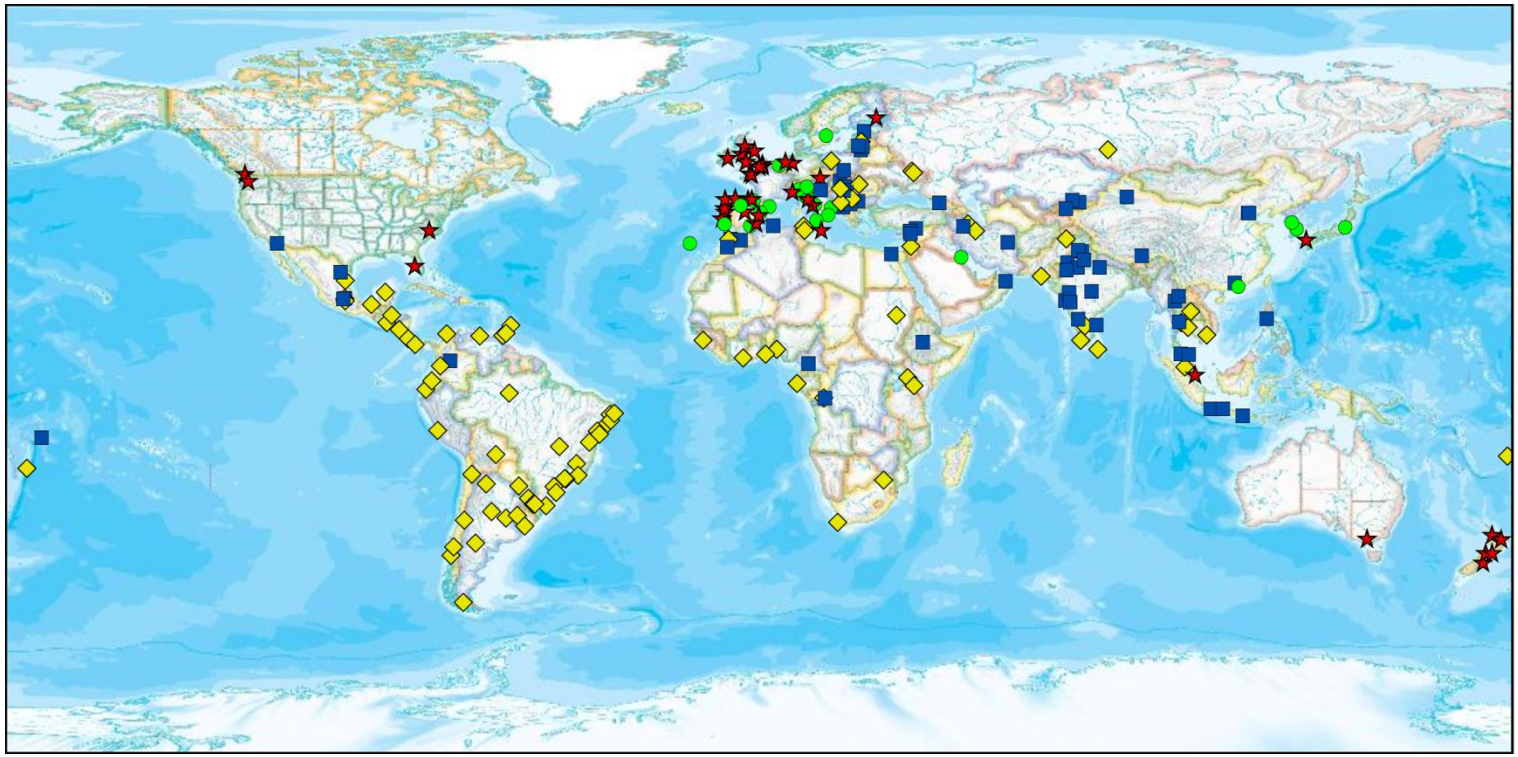
International Union Against Tuberculosis and Lung Disease

Health solutions for the poor

ISAAC

The International Study of Asthma and Allergies in Childhood

Geospatial distribution of prevalence of current symptoms of asthma and country income, 13-14 year age group – ISAAC3 Synthesis



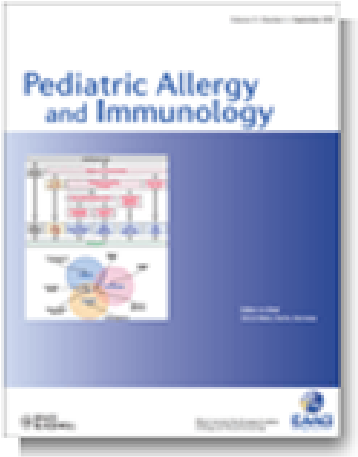
★ high prevalence of current symptoms of asthma (≥10%) and affluent (GNI >$9265)

◆ yellow diamonds high prevalence of current symptoms of asthma and non-affluent

● green circles low prevalence of current symptoms of asthma and affluent

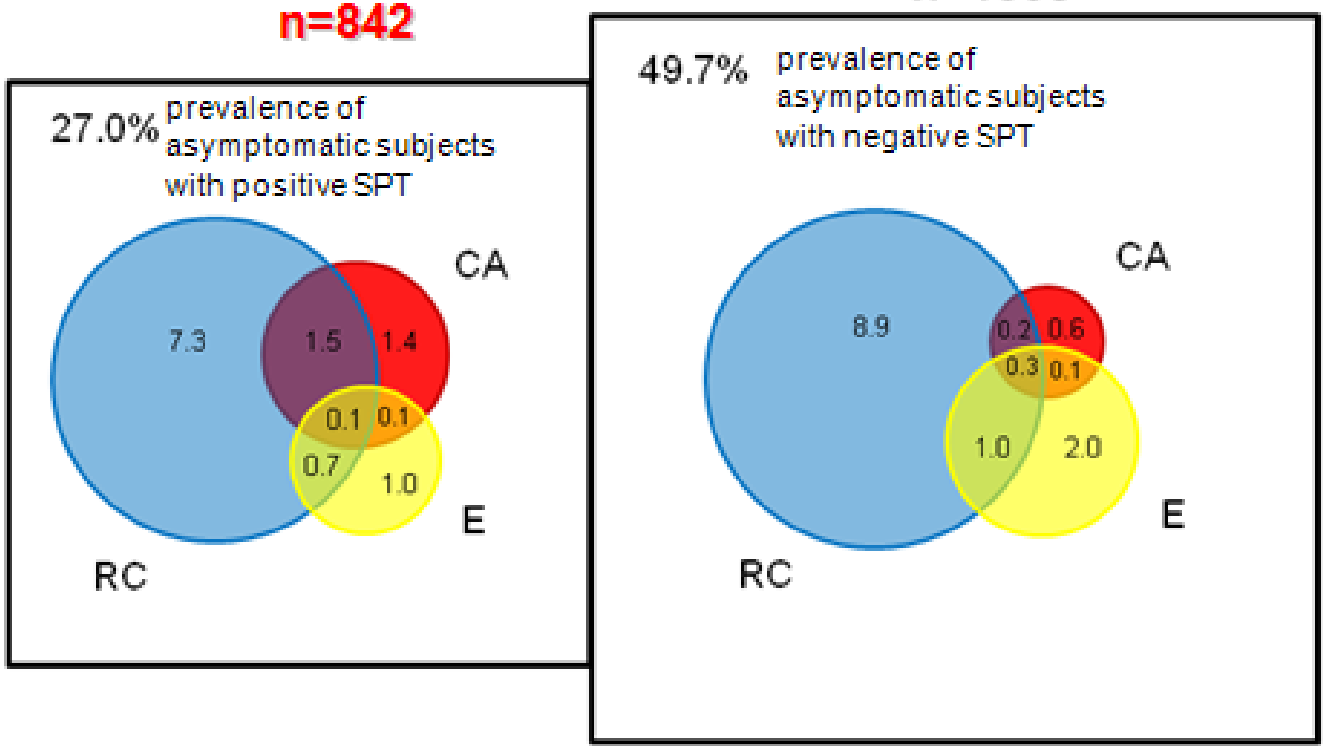
■ blue squares low prevalence of current symptoms of asthma and non-affluent

Proportional Venn diagram and determinants of allergic respiratory diseases in Italian adolescents



Atopici 39.2%
n=842

Non Atopici 60.8%
n=1308



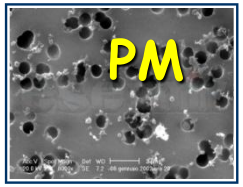
Il diagramma di Venn fornisce maggiori informazioni sulla prevalenza delle malattie allergiche coesistenti

Doppio diagramma di Venn per quantificare la distribuzione, nell'intero campione di popolazione, di **asma corrente (CA), rinocongiuntivite (RC)** ed **eczema (E)**, separatamente per i soggetti atopici (a sinistra) e non atopici (a destra).

Cibella F, Cuttitta G, La Grutta S, Melis MR, Lospalluti ML, Uasuf CG, Bucchieri S, Viegi G. Pediatric Allergy Immunol 2011;22:60-68.

Main Respiratory Effects related to Indoor Air

- Lung function reduction
- Increased respiratory symptoms
- Acute respiratory illnesses
- Asthma
- Bronchial hyper-responsiveness
- Chronic bronchitis
- Lung cancer



Indoor air pollution and airway disease

INT J TUBERC LUNG DIS 8(12):1401–1415

G. Viegi,* M. Simoni,* A. Scognamiglio,* S. Baldacci,* F. Pistelli,† L. Carrozzi,† I. Annesi-Maesano‡

* Pulmonary Environmental Epidemiology Unit, CNR Institute of Clinical Physiology, Pisa, † Cardiothoracic Department, University Hospital, Pisa, Italy; ‡ Epidemiology of Allergic and Respiratory Diseases Department, INSERM U472, Villejuif, France

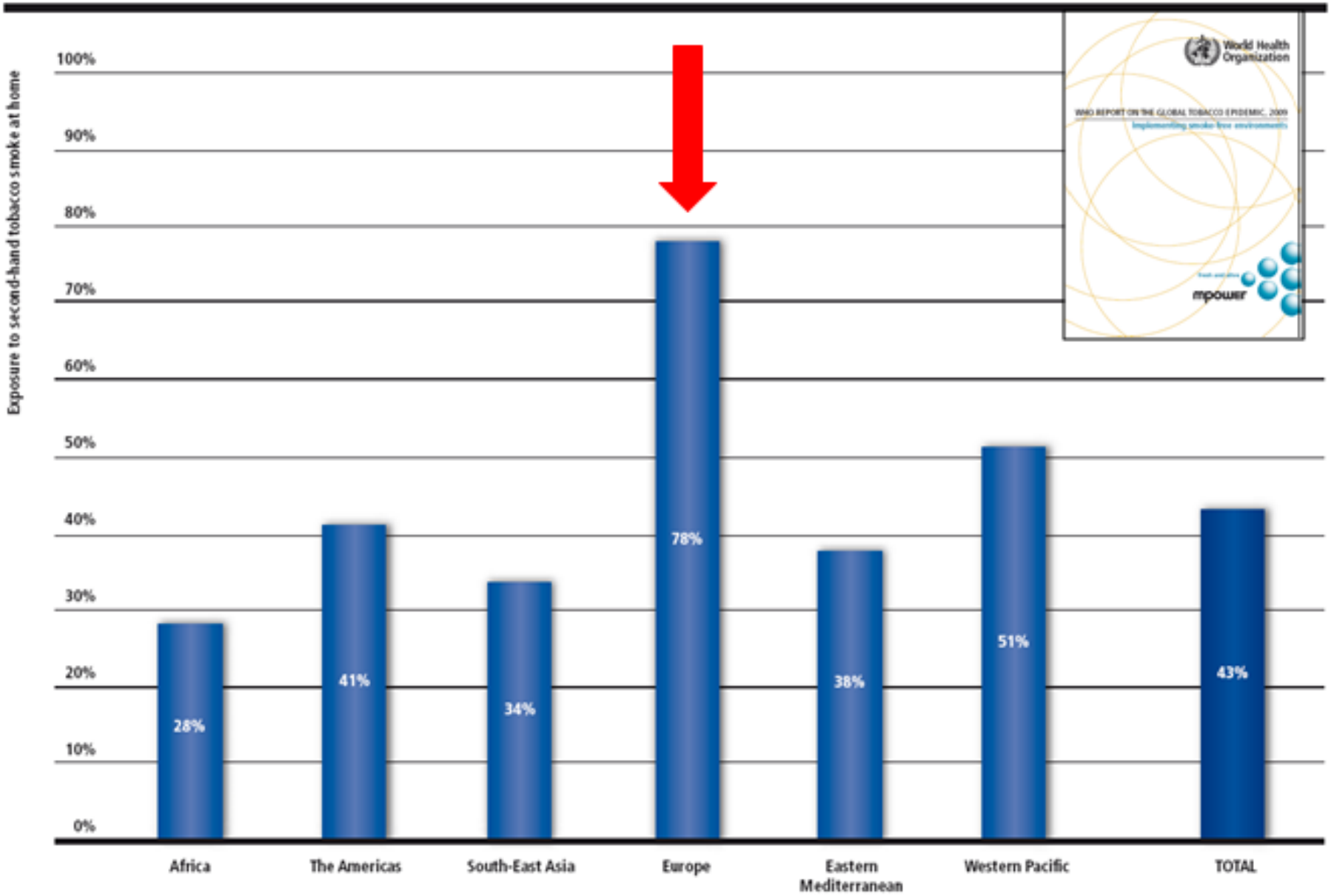
Table 3 Particulate matter (PM) level/environmental tobacco smoke (ETS)/biomass fuel as risk factors for respiratory health

First author (source)	Country (sample)	Risk factor	Disease/condition	OR (95%CI)
Simoni M, J Expo Anal Environ Epidemiol 2004[31]	Italy (adults)	$PM_{2.5}$ (high vs. low exposure)	Acute respiratory symptoms with fever	1.62 (1.04–2.51)
			Acute respiratory symptoms without fever	1.39 (1.17–1.66)
			Peak expiratory flow (PEF) variation	
			Increased maximum amplitude	1.38 (1.24–1.54)
			Increased diurnal variation	1.37 (1.23–1.53)
Neas L M, Am J Epidemiol 1994*	US (children)	$PM_{2.5}$ (30 μg/m³ increasing)	Respiratory symptoms	1.13 (0.99–1.30)
Wang T N, Environ Res 1999*	Taiwan (adolescent)	ETS	Asthma	1.08 (1.05–1.12)
Jedrychowski W, Int J Occup Environ Health 1995*	Poland (elderly women)	ETS	Dyspnoea	2.23 (1.45–3.44)
Leuenberger P, Am J Respir Crit Care Med 1994*	Swiss (adults)	ETS	Wheeze	1.94 (1.39–2.70)
			Asthma	1.39 (1.04–1.86)
			Dyspnoea	1.45 (1.20–1.76)
			Chronic bronchitis	1.65 (1.28–2.16)
Dayal H H, Environ Res 1994*	US (adults)	ETS	Obstructive respiratory diseases	1.86 (1.21–2.86)
Agabiti N, Epidemiology 1999*	Italy (children)	ETS	Asthma	1.34 (1.11–1.62)
Mishra V, Int J Epidemiol 2003*	Zimbabwe (children)	Biomass fuel	Acute respiratory illness	2.20 (1.16–4.19)
Qian Z, Proceedings Indoor Air 2002†	China (children)	Heating coal smoke	Bronchitis	
		Light		1.61 (1.35–1.92)
		Moderate		1.73 (1.42–2.12)
		Heavy		2.20 (1.81–2.68)
Xu X, Rev Respir Dis 1993*	US (adults)	Use of coal stove		
		Either cooking or heating	Wheeze with shortness of breath	2.90 (1.40–5.90)
		Both cooking and heating	Wheeze with shortness of breath	3.30 (1.70–6.30)
		Both cooking and heating	Cough	1.80 (1.00–3.30)
		Both cooking and heating	Phlegm	2.00 (1.20–3.40)

* Full reference available on Medline.
† Available from www.indoorair2002.org
OR = odds ratio; CI = confidence interval.

Esposizione a casa

AVERAGE PERCENTAGE OF 13–15-YEAR-OLDS LIVING IN A HOME WHERE OTHERS SMOKE, BY WHO REGION, 2008



Uno studio del 2011 ha dimostrato che THS rimane dopo che i fumatori se ne vanno dalle loro case, anche se queste rimangono vuote per due mesi per essere preparate per nuovi residenti (a volte anche con cambi di moquette e tinteggiatura).

When smokers move out and non-smokers move in: residential thirdhand smoke pollution and exposure

Georg E Matt,[1] Penelope J E Quintana,[2] Joy M Zakarian,[3] Addie L Fortmann,[4] Dale A Chatfield,[5] Eunha Hoh,[2] Anna M Uribe,[2] Melbourne F Hovell[2]

Tobacco Control 2011

What this paper adds

- Thirdhand smoke (THS) consists of tobacco smoke pollutants that remain on surfaces and in dust after tobacco has been smoked, are re-emitted and resuspended back into the air, or react with oxidants and other compounds in the environment to yield secondary pollutants.
- Evidence collected in field and controlled laboratory studies shows that indoor environments in which tobacco is regularly smoked become reservoirs of THS, potentially leading to the involuntary exposure of non-smokers to THS in the absence of concurrent smoking and long after smoking has taken place.
- This study is the first to examine whether private homes of smokers remain contaminated with THS after the smokers move out and non-smokers move in, and whether non-smokers who move into homes formerly occupied by smokers are exposed to THS through contaminated dust, surfaces and air in these homes.
- Findings indicate that THS accumulates in smokers' homes and persists when smokers move out even after homes remain vacant for 2 months and are cleaned and prepared for new residents. When non-smokers moved into homes formerly occupied by smokers, they encountered indoor environments with measurable THS polluted surfaces and dust. Results suggest that non-smokers living in former smoker homes are exposed to THS in dust and on surfaces.

Indoor air pollution and airway disease

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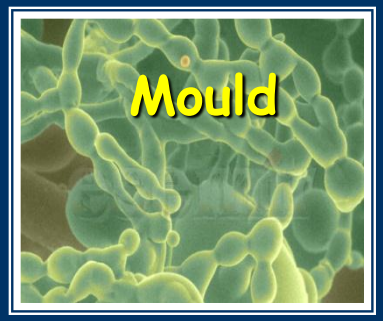
Association between Volatic Organic Compound (VOC) and respiratory health

Table 4 Volatile organic compounds (VOCs) and formaldehyde as risk factors for respiratory health

First author (source)	Country (sample)	Risk factor	Disease/condition	OR (95%CI)
Rumchev K B, Eur Respir J 2002[89]	Australia (children)	Formaldehyde (every 10 μg/m³ increase)	Asthma	1.003 (1.002–1.004)
Smedje G, Int J Tuberc Lung Dis 2001*	Sweden (children)	Formaldehyde (every 10 μg/m³ increase)	Asthma	1.20 (0.80–1.70)
Diez U, Int J Hyg Environ Health 2000*	Germany (infants)	Styrene Benzene	Pulmonary infections during the first 6 weeks of life	(styrene) 2.10 (1.10–4.20) (benzene) 2.40 (1.28–4.48)
Pitten F A, Dtsch Med Wochenschr 2000*	Germany (adults)	VOCs	Soreness of throat Irritation of mucous membranes	10.72 (1.46–465.20) 10.45 (1.43–453.80)
Garrett M H, Allergy 1999[90]	Australia (children)	Formaldehyde	Formaldehyde sensitisation	1.40 (0.98–2.00)
Wieslander G, Int Arch Occup Environ Health 1997*	Sweden (adults)	Newly painted surfaces (a) Newly painted wood details (b) Kitchen painting (c)	Asthma (combination of bronchial hyperresponsiveness and asthma-related symptoms)	(a) 1.50 (1.00–2.40) (b) 2.30 (1.20–4.50) (c) 2.20 (1.10–4.50)
Norback D, Occup Environ Med 1995*	Sweden (adults)	VOCs (a) Formaldehyde (b)	Nocturnal breathlessness	(a) 9.90 (1.70–58.80) (b) 12.50 (2.00–77.90)

* Full reference available on Medline.
OR = odds ratio; CI = confidence interval.



Indoor air pollution and airway disease

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Table 5 Mould/dampness exposure as risk factor for respiratory health

First author (source)	Country (sample)	Disease/condition	OR (95%CI)
Spengler J D, Proceedings Indoor Air 2002[65]	Russia (children/adolescents)	Wheeze	1.35 (1.08–1.70)
		Asthma symptoms	1.79 (1.41–2.27)
		Bronchitis	1.60 (1.34–1.91)
Jaakkola M S, Environ Health Perspect 2002*	Finland (adults)	Asthma	1.54 (1.01–1.32)
Kilpelainen M, Thorax 2001*	Finland (young adults)	Asthma	2.21 (1.48–3.28)
Zacharasiewicz A, Allergy 2000*	Austria (children)	Rhinitis	1.51 (1.31–1.74)
Norback D, Int J Tuberc Lung Dis 1999[66]	Sweden (adults)	Asthma symptoms	1.80 (1.10–3.00)
Jedrychowski W, Int J Occup Med Environ Health 1998*	Poland (children)	Wheeze	1.63 (1.07–2.48)
Nicolai T, Thorax 1998*	Germany (children)	Bronchial hyper-reactivity	5.77 (1.17–28.44)
Nafstad P, Am J Respir Crit Care Med 1998[24]	Norway (adults)	Bronchial obstruction	3.80 (2.0–7.20)
Fisher P H, Indoor Air 1998*	UK-CZ-PL (children/adolescents)	Wheeze	1.29 to 1.60 (1.06–1.97)
Yang C Y, Pediatr Pulmonol 1997*	Taiwan (children/adolescents)	Wheeze	1.81 (1.32–2.47)
		Cough	1.71 (1.42–2.06)
		Asthma	1.73 (1.20–2.49)
Li C S, Arch Environ Health 1996*	China (children/adolescents)	Rhinitis	1.37 (1.03–1.83)
		Cough	5.74 (2.20–14.95)
Strachan D P, Thorax 1990*	UK (children)	Wheeze	3.70 (2.22–6.15)

* Full reference available on Medline.
OR = odds ratio; CI = confidence interval; UK = United Kingdom; CZ = Czech Republic; PL = Poland.

ORIGINAL ARTICLE *Occup. Environ. Med.* 2005;62;616-622

Mould/dampness exposure at home is associated with respiratory disorders in Italian children and adolescents: the SIDRIA-2 Study

M Simoni, E Lombardi, G Berti, F Rusconi, S La Grutta, S Piffer, M G Petronio, C Galassi, F Forastiere, G Viegi, the SIDRIA-2 Collaborative Group

Stima dell'associazione tra esposizione corrente a muffa e fischi/asma nei bambini.

Table 5 Estimated odds ratios (OR) and 95% confidence intervals (95% CI) for the association between mould/dampness current exposure and wheeze/asthma in the literature (questionnaire based studies)

Author (publication year)	n	Age	Design. Definition of mould/dampness exposure	Symptom/disease	OR (95% CI)
Present study	17918	7	Cross sectional. Positive answer to the question: "Have you seen mould/dampness/fungi on the walls or on the ceiling of your child's bedroom recently?"	Wheeze	1.78 (1.43–2.20)
				Asthma	1.29 (1.00–1.67)
	11957	13		Wheeze	1.33 (1.02–1.74)
				Asthma	1.38 (1.03–1.85)
Jedrychowski *et al* (1998)[9]	1129	9	Cross sectional. Presence on the walls of any one of: (1) small moisture stains; (2) larger moisture stains; (3) visible mould on small surface; (4) visible mould on larger surface	Wheeze	1.63 (1.07–2.48)
Fisher *et al* (1998)[36]	16005	7–11	Cross sectional. Presence on the walls of damp spots or mould during the last two years	Wheeze	1.29 (1.06–1.58) to 1.60 (1.30–1.97)
Yang *et al* (1997)[23]	4164	6–12	Cross sectional. Presence of any one of: (1) subjective dampness assessment (home was considered damp by the residents); (2) visible mould or mildew on surfaces inside the home during the past year; (3) appearance of standing water within the home/water damage/leaks of water into the building	Wheeze	1.81 (1.32–2.47)
				Asthma	1.73 (1.20–2.49)
Dekker *et al* (1991)[38]	14059	5–8	Cross sectional. Presence of any one of: (1) visible mould growth; (2) wet or damp spots on indoor surfaces; (3) basement water damage or leaking	Wheeze	1.61 (1.39–1.85)
Dales *et al* (1991)[28]	14948	5–8	Cross sectional. Presence of any one of: (1) visible mould growth; (2) wet or damp spots on indoor surfaces; (3) basement water damage or leaking	Asthma	1.45 (1.23–1.71)

EUROPE

DAMP AND MOULD

Health risks, prevention and remedial actions

Information brochure

2009

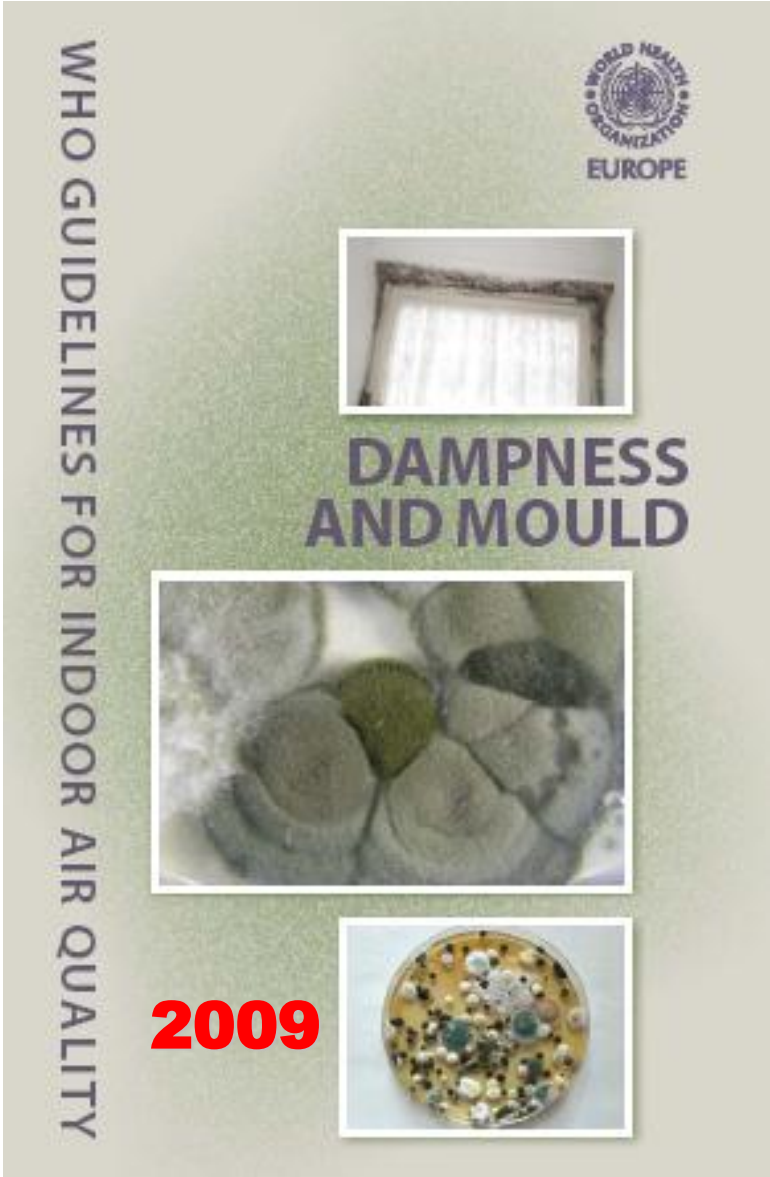
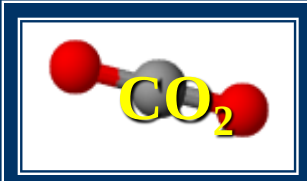


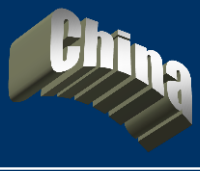
Table 7. Key results of the meta-analyses of Fisk, Lei-Gomez and Mendell (2007)

Outcome	Participants	No. of studies	Odds ratio (95% CI)	Estimated % increase in outcome in houses with visible dampness, mould or mould odour
Upper respiratory tract symptoms	All	13	1.70 (1.44–2.00)	52
Cough	All	18	1.67 (1.49–1.86)	50
	Adults	6	1.52 (1.18–1.96)	–
	Children	12	1.75 (1.56–1.96)	–
Wheeze	All	22	1.50 (1.38–1.64)	44
	Adults	5	1.39 (1.04–1.85)	–
	Children	17	1.53 (1.39–1.68)	–
Current asthma	All	10	1.56 (1.30–1.86)	50
Ever-diagnosed asthma	All	8	1.37 (1.23–1.53)	33
Asthma development	All	4	1.34 (0.86–2.10)	30

Note. CI, confidence interval

WHO GUIDELINES FOR INDOOR AIR QUALITY: DAMPNESS AND MOULD, 2010





1: Indoor Air. 2006 Dec;16(6):454-64.

Current asthma and respiratory symptoms among pupils in Shanghai, China: influence of building ventilation, nitrogen dioxide, ozone, and formaldehyde in classrooms.

Mi YH, Norbäck D, Tao J, Mi YL, Ferm M.

Multiple logistic regression model

Pollutant	Outcome	OR	p
CO_2 (increment: 100ppm)	Current asthma	1.18	< 0.01
	Asthma medications	1.15	< 0.05
NO_2 (increment: 10 μg/m^3)	Current asthma	1.51	< 0.01
	Asthma medications	1.45	< 0.01

: J Occup Environ Med. 2006 May;48(5):462-9.

Australia

A cohort study of indoor nitrogen dioxide and house dust mite exposure in asthmatic children.

Nitschke M, Pilotto LS, Attewell RG, Smith BJ, Pisaniello D, Martin J, Ruffin RE, Hiller JE.

Classroom NO_2 leves measured repeatedly in winter	Outcome	OR	IC 95%
NO_2 (10 ppb increase)	Difficulty breathing during the day	1.09	1.03-1.15
	Difficulty breathing at night	1.11	1.07-1.13
	Chest thightness at night	1.12	1.07-1.17

1: Rev Port Pneumol. 2008 Jul-Aug;14(4):487-507.

Indoor air quality and respiratory symptoms in Porto schools.

[Article in English, Portuguese]

Fraga S, Ramos E, Martins A, Samúdio MJ, Silva G, Guedes J, Oliveira Fernandes E, Barros H.

AIM: To evaluate the association between the indoor air quality in Porto schools and the prevalence of allergic and respiratory symptoms in adolescents.

SAMPLE: 1607 adolescents, with a mean age of 14.0 years (standard deviation=0.3).

RESULTS: After adjustment for parental educational attainment level, CO_2 > 2100 ppm values were associated with exercise- induced wheeze [OR=1.86 (95%CI:1.20-2.89)] and night cough [OR=1.40 (4.20-2.89)].

Public Health

The European HESE Study (Health Effects of School Environment)

http://ec.europa.eu/health/ph_projects/2002/pollution/pollution_2002_04_en.htm

The HESE study involved .....

Country	Centre	N Schools*	(N classrooms)
1. Italy	1. Siena	4	8
	2. Udine	4	8
2. Norway	3. Oslo	3	6
3. Sweden	4. Uppsala	4	9
4. Denmark	5. Ärhus	2	7
5. France	6. Reims	4	8
Total		**21**	**46**

*** attended from more than 600 children with age 9-10 years; about half of schools in more polluted and half in less polluted areas**

Eur Respir J 2010; 35: 742–749
DOI: 10.1183/09031936.00016309

School air quality related to dry cough, rhinitis and nasal patency in children

M. Simoni*, I. Annesi-Maesano[#], T. Sigsgaard[¶], D. Norback[+], G. Wieslander[+], W. Nystad[§], M. Canciani[f], P. Sestini and G. Viegi*,[##]**

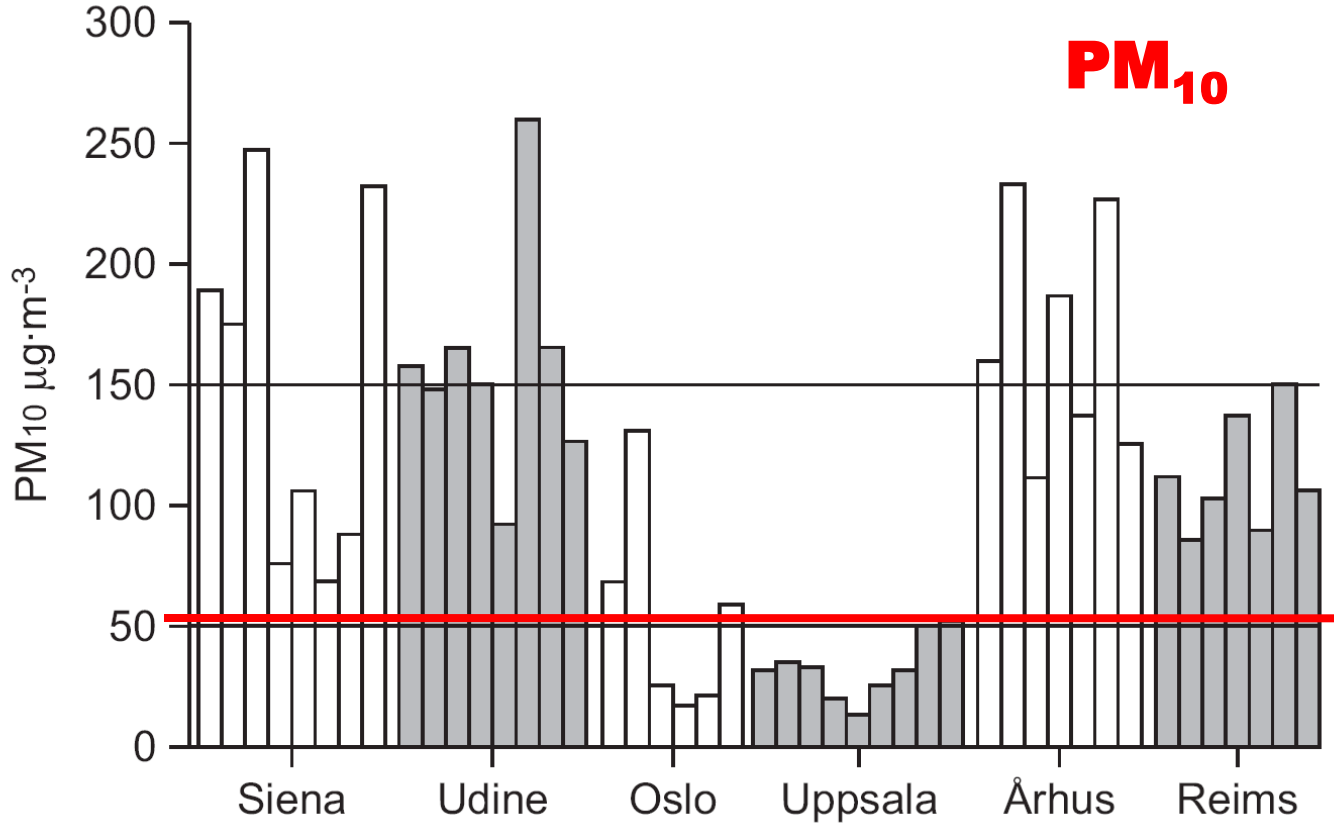


FIGURE 1. Indoor particulate matter with a 50% cut-off aerodynamic diameter of 10 µm (PM10). Classroom mean concentration by centre. The line at 50 $\mu g \cdot m^{-3}$ shows the US Environmental Protection Agency (EPA) annual standard. The line at 150 $\mu g \cdot m^{-3}$ shows the US EPA 24-h standard.

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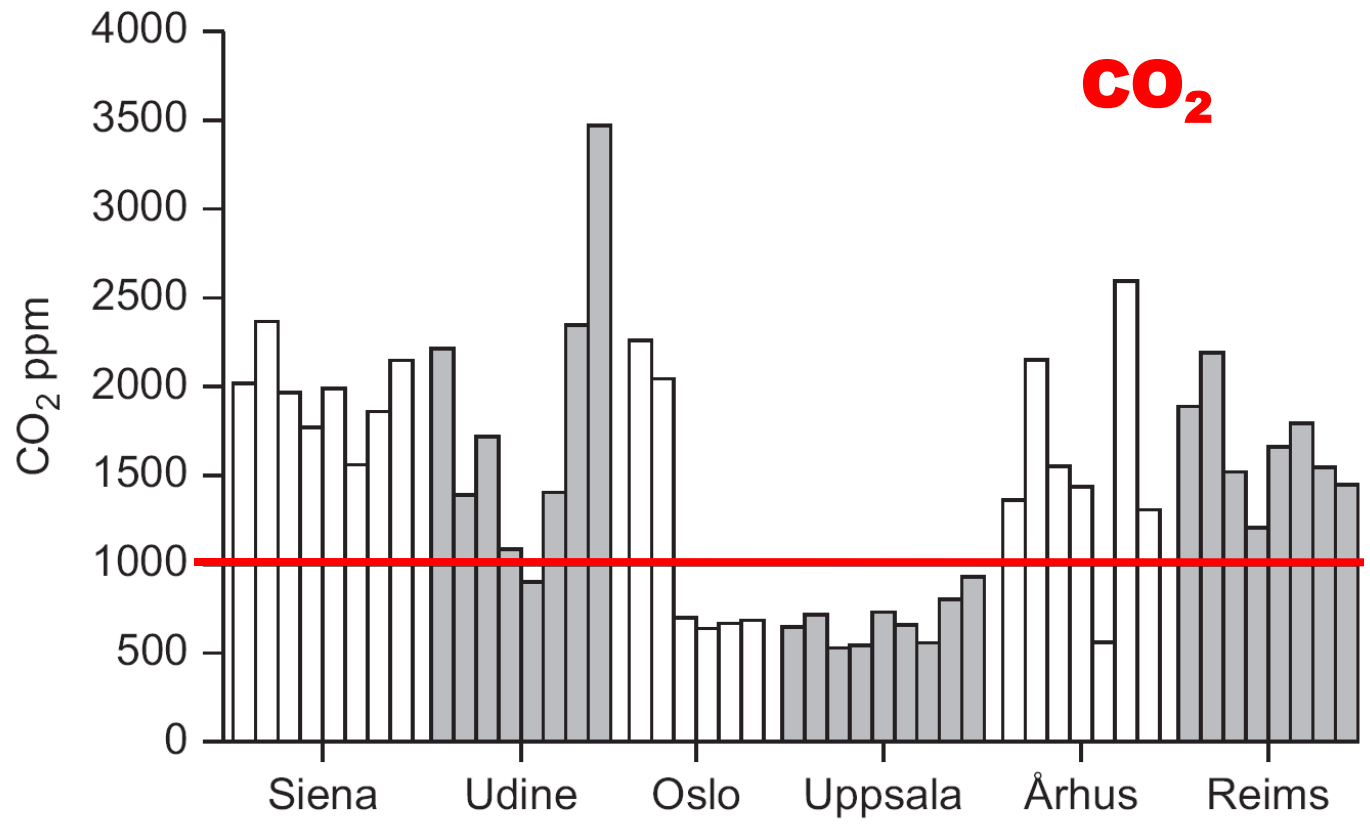

FIGURE 2. Indoor CO_2. Classroom mean concentration by centre. The line at 1,000 ppm shows the American Society of Heating, Refrigerating, and Air Conditioning Engineers standard.

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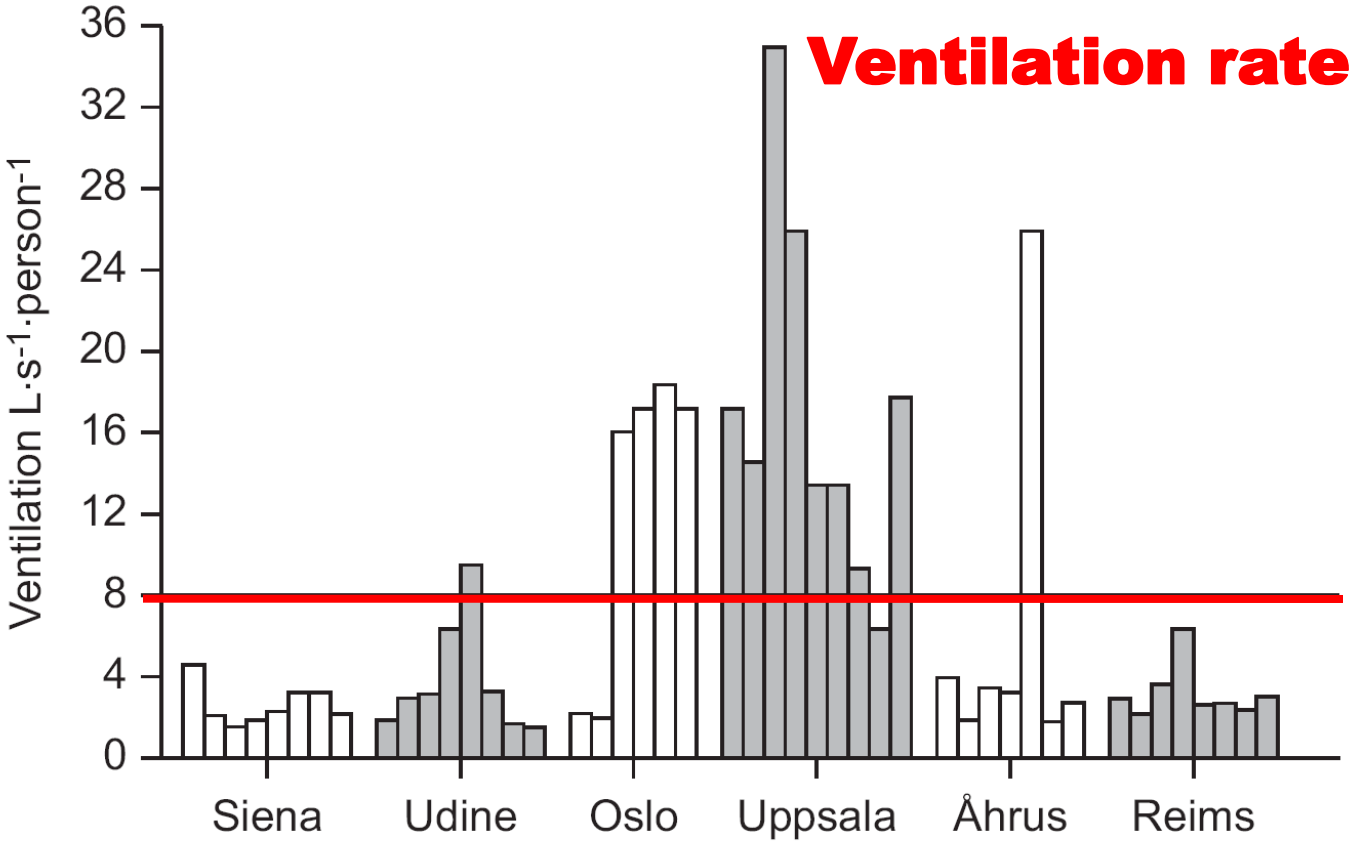

FIGURE 3. Ventilation rate. Mean personal outdoor supply rate by centre. The line at 8 $L \cdot s^{-1} \cdot person^{-1}$ shows the American Society of Heating, Refrigerating, and Air Conditioning Engineers standard.

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TABLE 3 Prevalence of recent respiratory disorders by indoor exposure level of particulate matter (PM_{10}) and CO_2, and associations of respiratory disorders with exposure levels (reference: low level)

	Low	Elevated[#]	p-value	Conventional logistic regression models		Two-level[¶] hierarchical regression models
				Crude OR (95% CI)	Adjusted OR[+] (95% CI)	Adjusted OR[+] (95% CI)
PM_{10} $\mu g \cdot m^{-3}$						
Wheeze	11.8	13.8	NS	1.20 (0.65–2.22)	1.22 (0.51–2.91)	0.98 (0.93–1.04)
Dry cough at night	20.8	38.6	<0.001	2.39 (1.49–3.86)***	1.21 (0.63–2.31)	0.89 (0.27–2.96)
Rhinitis	28.6	31.9	NS	1.17 (0.76–1.82)	0.72 (0.38–1.36)	0.59 (0.22–1.57)
CO_2 ppm						
Wheeze	11.9	13.9	NS	1.20 (0.72–2.01)	1.24 (0.55–1.03)	1.52 (0.68–3.39)
Dry cough at night	21.0	40.0	<0.001	2.52 (1.69–3.76)***	2.99 (1.65–5.44)**	3.32 (1.21–9.09)*
Rhinitis	25.9	34.1	<0.05	1.47 (1.01–2.16)*	2.07 (1.14–3.73)*	1.76 (0.71–4.38)

[#]: PM_{10} >50 $\mu g \cdot m^{-3}$, CO_2 >1,000 ppm. [¶]: first level, child; second level, classroom. [+]: analysis accounted for passive exposure to tobacco smoking at home, sex, age, PM_{10} (increment: 10 $\mu g \cdot m^{-3}$), and CO_2 (increment: 100 ppm). NS: not significant. *: p<0.05; **: p<0.01; ***: p<0.001. p-values were calculated using Chi-squared test.

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Pediatric Allergy and Immunology **22** (2011) 843–852 © 2011

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Total viable molds and fungal DNA in classrooms and association with respiratory health and pulmonary function of European schoolchildren

Marzia Simoni[1], Gui-Hong Cai[2], Dan Norback[2], Isabella Annesi-Maesano[3,4], François Lavaud[5], Torben Sigsgaard[6], Gunilla Wieslander[2], Wenche Nystad[7], Mario Canciani[8], Giovanni Viegi[1,9] & Piersante Sestini[10]

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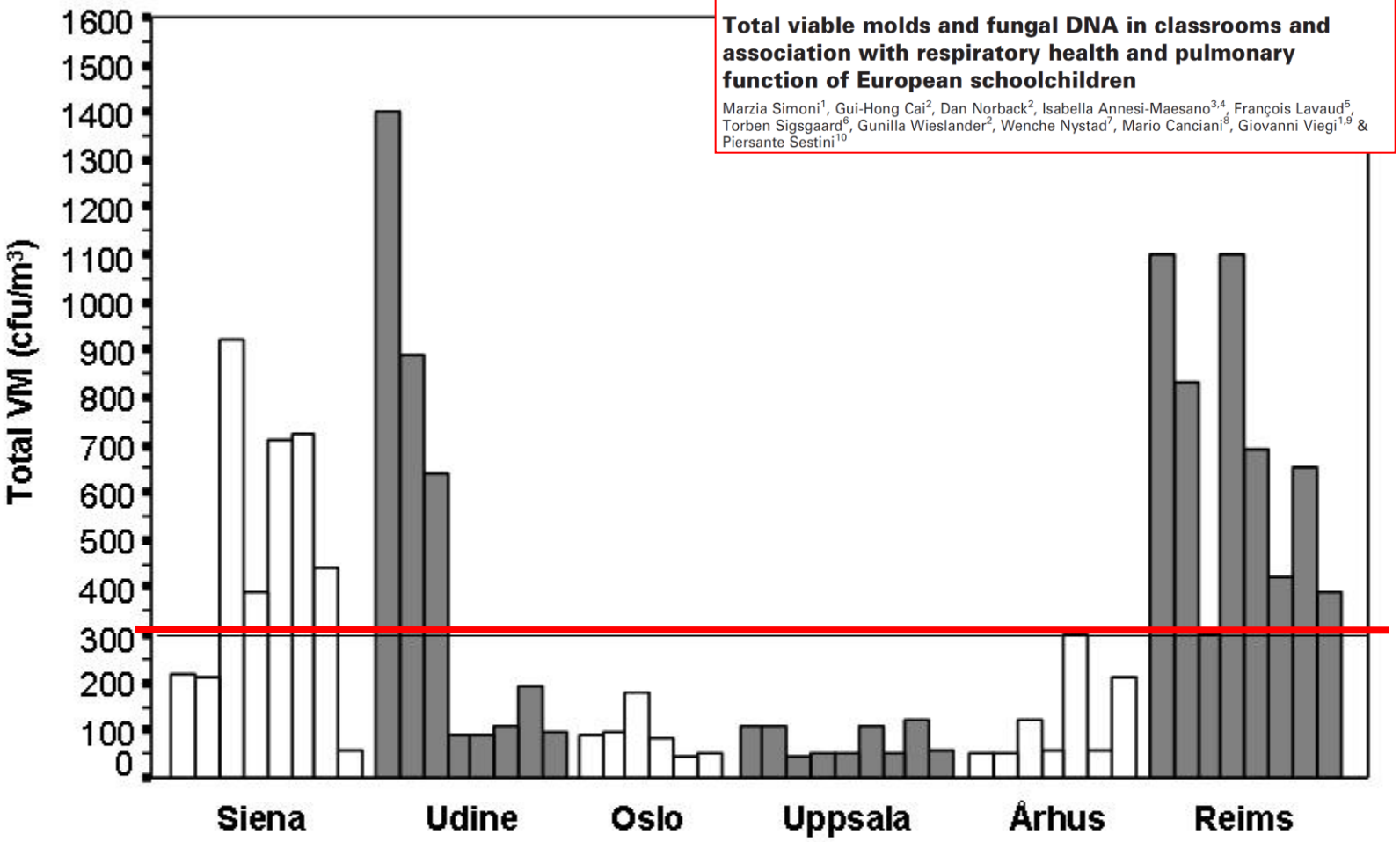

Figure 1. Concentrations of total viable moulds (VM) in monitored classrooms. The horizontal line indicates the maximum standard value proposed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for good indoor air (300 cfu/m3).

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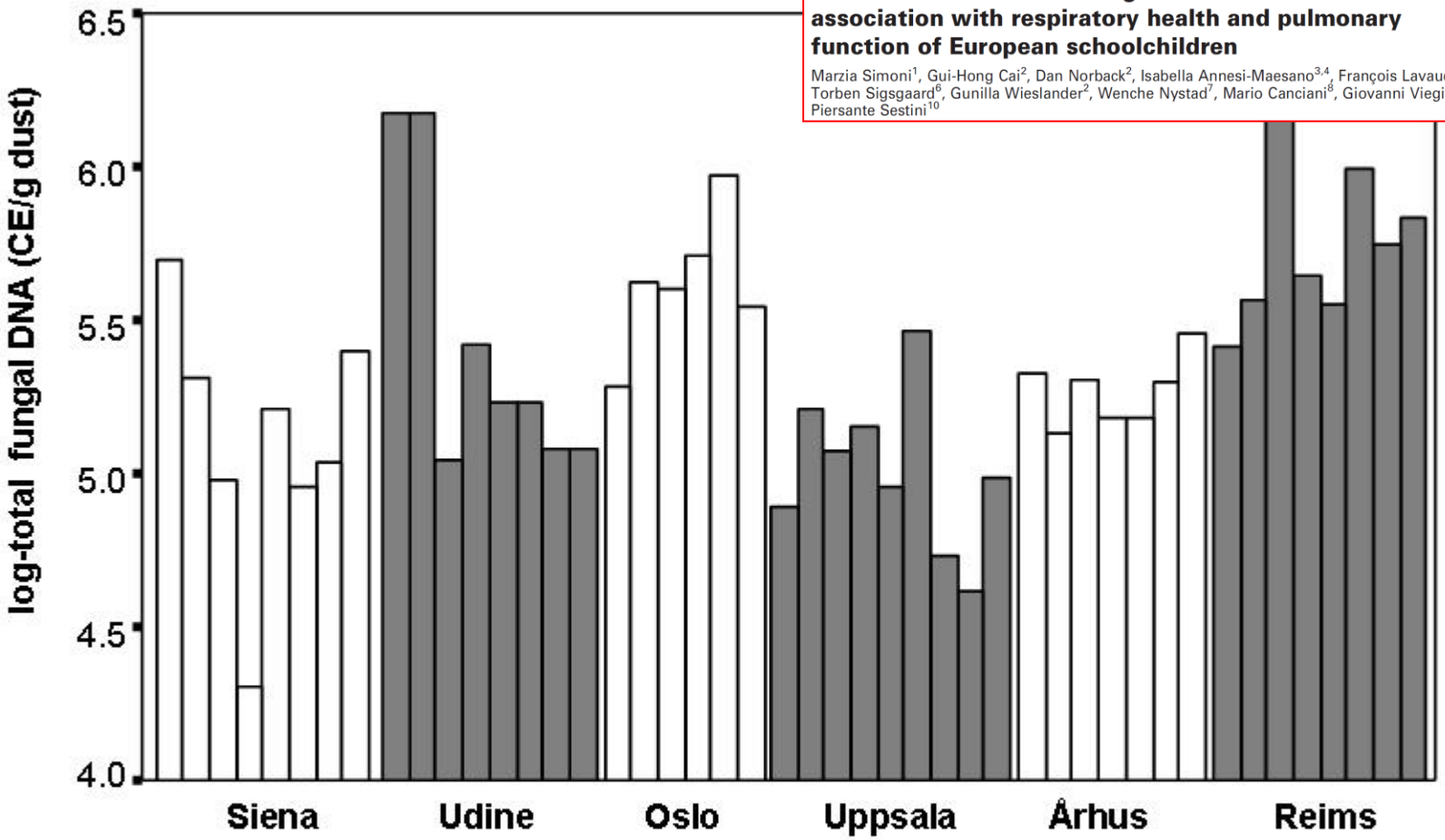

Figure 2. Concentrations of total fungal-DNA in monitored classrooms.

- ✓VM exposure was related to respiratory symptoms/diseases, whereas it did not seem to affect respiratory function of schoolchildren.

- ✓Total fungal DNA significantly affected neither considered symptoms/diseases nor pulmonary function, but significant associations were found when the analyses were conducted on the various fungal *genera*.

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