Environ Health Prev Med (2011) 16:73–79
DOI 10.1007/s12199-010-0171-0

REVIEW

Environmental home inspection services in Western Europe

Denis Charpin · Ralph Baden · Valérie Bex · Sandrine Bladt · Carmel Charpin-Kadouch · Catherine Keimeul · Pedro da Mata · Frédéric de Blay · Martyna Kuske · Yvon Le Moullec · Alain Nicolas · Martine Ott · Roger Marc · Chrisbelle Speyer · Daniel Vervloet · Fabien Squinazi

Received: 7 March 2010 / Accepted: 20 July 2010 / Published online: 14 August 2010

Abstract This review deals with environmental home inspection services in Western Europe provided for patients at the request of attending physicians to improve patient management. Such requests are usually motivated by respiratory or general symptoms which occur or worsen at home. The visit includes a standardised questionnaire as well as environmental sampling such as mite-allergen measurement, mould identification and volatile organic compound (VOC) measurements. Besides, some non-respiratory indoor risks are also taken into account. Following the visit, a report is sent to the family and the attending physician. These services have been developed since the early 1990s, but evaluation of their efficacy is still limited. Some studies have demonstrated a reduction in mite-allergen levels and clinical improvement following the visit and implementation of advice provided to the family. However, more studies are needed to further document efficacy and also perform cost–benefit analysis of these services.

Keywords Health–environment · Housing · Indoor allergens · Volatile organic compounds

Establishment of environmental home inspection services

The relevance of indoor aero-contaminants to chronic respiratory diseases, especially asthma, has been fully acknowledged [1, 2]. The US National Asthma Education

D. Charpin (✉) · C. Charpin-Kadouch
Department of Pneumonology and Allergy,
North Hospital, Chemin des Bourrelly,
13015 Marseille, France
e-mail: denis-andre.charpin@ap-hm.fr

R. Baden
Division de la Santé au Travail,
Direction de la Santé, Grand Duché de Luxembourg,
Luxembourg

V. Bex · Y. Le Moullec · F. Squinazi
Laboratoire d'Hygiène de la Ville de Paris,
Paris, France

S. Bladt
CRIPI, Bruxelles, Belgium

C. Keimeul
SAMI-Namur, Namur, Belgium

P. da Mata
Housing and Health Quality, Lisbon, Portugal

F. de Blay · M. Ott
Strasbourg University Hospitals,
Strasbourg, France

M. Kuske
SAMI-Lux, Observatoire de la Santé,
Marloie, Belgium

A. Nicolas
Maison de la Qualité de Vie, Liège, Belgium

R. Marc
Hainaut Vigilance Sanitaire, Service LPI,
Mons, Belgium

C. Speyer · D. Vervloet
Association Asthme et Allergies,
Marseille, France

and Prevention Program for the Management of Asthma includes special attention to environmental triggering factors [3]. Besides aero-contaminants, other indoor risk factors such as lead poisoning, domestic accidents or other risks also need to be evaluated in the environmental inspection. Such dedicated services were created at about the same time, in the early 1990s, at the Strasbourg University Hospitals in France (CMEI) and at the Institute for Indoor Diagnostic (IFID) in Germany, then in Switzerland and Sweden in 1994, being called "green ambulances" in these latter countries. Their objective was to assess a whole array of physical, chemical as well as biological indoor environmental risks. Such services have subsequently been developed in Luxembourg by the Ministry of Health, Luxembourg (MHL) [4] and in Belgium in the form of the Service d'Analyse des Milieux Intérieurs (SAMI) Liège (htttp://www.sami.be), SAMI Namur and Cellule Régionale d'Intervention en Pollution Intérieure (CRIPI) in the Bruxelles area [5] and Laboratoire d'Etude et de Prévention des Pollutions Intérieures (LPI) in the Hainaut Province of Belgium, and SAMI-Lux in the Luxembourg Wallon Province in 2002 (http://www.sami.be). SAMI Braban Wallon was set up in 2008. From 1998 to 2004, Interenvironment Wallonie coordinated in Bruxelles an interdisciplinary network, the Sandrine project [6], an integrated strategy for health, environment and sustainability. In France, a service devoted to the assessment of respiratory health hazards was developed by the Strasbourg University Hospitals in 1991 (Conseillers Médicaux en Environnement Intérieur, CMEI) [7, 8] and in the early 2000s by the Paris City (Laboratoire d'Hygiène de la Ville de Paris, LHVP) [9]. The CMEI service has also been implemented in Portugal (Housing & Health Quality, H_2Q) [10] and in Marseille, France [11]. In southern France, a service (Conseil Habitat-Santé, CHS) was developed in 2001 after the green ambulance service to assess a large array of respiratory and non-respiratory indoor health hazards [12, 13]. All these services are activated because of health complaints. In addition, there are institutional services in various countries, especially in main towns, which are dedicated to inhabitants' environmental complaints. This review will only consider the former group, i.e., those services that are activated by the attending physician when a relationship between housing conditions and health is questioned.

In this review, we will present the services provided by environmental home inspection organisations, their current achievements and future developments.

Services provided by the different organisations

- The name of each service, its location, year of establishment and measurements performed are presented in Table 1. Only data which have been published or appear on the website of the organisation are listed. General symptoms refer to fatigue, myalgia or dizziness.
- All teams use a standardized questionnaire (data refer to current symptoms) and perform environmental sampling of biological, chemical and physical pollutants (Table 1)

Biological pollutants

- Environmental sampling includes collection of house dust from mattress, floor and other sites. All services, except LHVP and CMEI, which performs a mite-allergen measurement using an enzyme-linked immuno sorbent assay (ELISA) technique, rely on assessment of guanine content using the Acarex test. This test enables cheap, semi-quantitative, on-site evaluation of the mite-allergen content of house dust [14]. The results indicate positive results as (++) and (+++) for high exposure to mite allergens [14]. Exposure to pet allergens is assessed through questionnaire and visual inspection, but in Strasbourg University Hospitals by also measuring cat or dog major allergens using ELISA.
- When visual inspection shows mouldy surfaces, all teams perform direct environmental sampling by the scotch test [15] and a contact method, together with air, material or dust sampling in most services [16].

Chemical pollutants

- Measurements of volatile organic compounds (VOC) are performed by most teams, following selection of the most appropriate analysis to be performed in relation of data from the questionnaire and home inspection. VOC analysis of air samples was performed in 41% and formaldehyde measurements in 28% of dwellings inspected by IFSI [4]. Pesticides are investigated by CRIPI and SAMI-Lux on air or dust samples. MHL performs a comprehensive evaluation of indoor chemical pollutants [4]. CO_2 measurement is used by IFSI and LHVP to compute the air exchange rate. IFSI as well as the CHS service measure CO levels. The CHS service identifies the risk of lead poisoning based on the age of the building and the presence of children aged 6 years or less (no measurement of lead, which is performed by an administrative agency following the CHS visit). LHVP performs measurements of lead in wall paint in case of lead poisoning. MHL performs measurements of biocides, flame retardants, polychlorobiphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), phthalates and VOC.

Table 1 Organisations performing home inspections, and methods used to identify domestic health hazards

	IFID, Düsseldorf, Germany, 1992	MHL, Luxembourg, Luxembourg, 1994	SAMI-LG, Liège, Belgium, 1994	SAMI-Lux, Marloie, Belgium, 2002	SAMI Namur, Belgium, 2002	CRIPI Bruxelles, Belgium, 2000
House dust mites	Acarex test	–	Acarex test	Acarex test	Acarex test	Acarex test
Moulds	Air/material samples	Air samples	Scotch test	Scotch test	Scotch test	Scotch test
		Contact samples	Air samples	Air samples	Air samples	Air samples
			Contact samples	Contact samples	Contact samples	Dust samples
VOC/aldehydes	+	+	+	+	+	+
Other chemicals	Biocides	Biocides, pyrethroids, flame retardants, PCB, PAH, phthalates	–	Lead	Lead	Biocides
	Asbestos			Biocides	Biocides	PM 1, 2.5 and 10 μm
				Pyrethroids	Pyrethroids	
						Lead
Bacteria	–	–	*Legionella*	–	–	–
Physical hazards		Radon, EMF, fibres	Radon	Radon	Radon	–
	H_2Q, Lisbon, Portugal, 2002	LPI, Mons, Belgium, 2004	CMEI, Strasbourg, France, 1991	CMEI, Marseille, France, 2004	CHS, Marseille, France, 2002	LHVP, Paris, France 2001
House dust mites	Acarex test	Acarex test	Acarex test	Acarex test	Acarex test	Mite allergens (ELISA)
Moulds	Scotch test	Scotch test	Scotch test	Scotch test	Scotch test	Scotch test and contact method
		RODAC	Air samples			Air samples
		Air samples	Dust samples			Dust samples
VOC/aldehydes	_	+	+	+	+	+
Other chemicals	_	Lead	Mineral fibres	_	_	Lead
		CO_2, CO	Pesticides			Asbestos, mineral fibres, CO_2
Bacteria	_	*Legionella*, non-tuberculous mycobacteria, *Actinomycetes*, endotoxin	_	_	_	Air samples
Physical hazards	Radon	Radon	_	_	Domestic accidents	Temperature, relative humidity
					Noise	
					EMF	
					Electric circuits	
					CO	

IFID Institute for Indoor Diagnostic, Dusseldorf, Germany; *MHL* Ministry of Health, Luxemburg; *SAMI* Service d'Analyse des Milieux Intérieurs; *H2Q* Housing and Health Quality, Lisbon, Portugal; *LPI* Laboratoire d'Etude et de Prévention des Pollutions Intérieures, Mons, Belgium; *CRIPI* Cellule Régionale d'Intervention en Pollution Intérieure, Bruxels, Belgium; *CMI* Conseiller Médical en Environnement Intérieur (Medical Indoor Environment Counsellor), Strasbourg, France; *CHS* Conseiller Habitat Santé (Housing and Health Counsellor), Marseille, France; *LHVP* Laboratoire d'Hygiène de la Ville de Paris (Paris Hygiene Institute), Paris, France; *PCB* polychlorobiphenyls; *PAH* polycyclic aromatic hydrocarbons; *EMF* electromagnetic fields; *ELISA* enzyme-linked immunosorbent assay

Physical pollutants

According to teams, measurements of indoor air and/or wall temperature and humidity are performed. SAMI-Lux measures exposure to radon. CRIPI may measure lead levels on pipes and paint, and in some instances asbestos fibres. The CHS service evaluates risk of domestic accidents and noise, measures electromagnetic fields and checks CO air levels. MHL provides measurements of radon, asbestos fibres and electromagnetic fields.

Logistics

Who asks for such an environmental inspection?

- All services ask the attending physician, general practitioner or specialist to be the starting point and write a prescription. This document is sent to the service, which phones the family to arrange an appointment. A housing inspection from CRIPI and MHL can also be requested directly by patients, but they will then have to pay for the service. IFID performed 10% of inspections at the request of a private person who wished to check a dwelling before buying it or was involved in a legal procedure. SAMI-Liège reports 70% direct requests from patients (http://www.sami.be). MHL [5] reports 45% prescriptions and 55% direct requests from patients

Which symptoms lead to environmental inspections? (Table 2)

In the IFID experience, bronchial symptoms are acknowledged by 63% of persons living in inspected dwellings, ear, nose, throat (ENT) symptoms by 58%, "allergies" by 49%, headaches by 46% and recurrent infections by 45%. In the CHS service, 69% of patients complain of rhinitis, 52% asthma, 18% conjunctivitis, 10% recurrent bronchitis and 8% chronic cough [13]. In the CRIPI statistics, the symptoms leading to a call are, in order of decreasing importance: asthma, nocturnal cough, recurrent respiratory infections, respiratory or ENT allergy, respiratory symptoms and hypersensitivity pneumonitis (http://www.sami.be). In the MHL experience [4], the main groups of symptoms leading to indoor investigations are irritation of nose, eyes and skin (31%), respiratory problems (including cough, asthma and recurrent bronchitis) (25%), systemic symptoms (headaches, nausea, dizziness, muscular and joint pain) (21%), sleeping problems (10%) and skin irritation (9%). Of dwellings, 5% were investigated for prevention. CMEI was also involved in diagnosis of invasive aspergillosis [17]

Table 2 Symptoms reported by patients who had a home environmental inspection (in some organisations, several symptoms were recorded for a given patient)

	IFID ($n = 500$)	MHL ($n = 724$)	SAMI-Liège ($n = 484$)	SAMI-Lux ($n = 280$)	CRIPI ($n = 317$)	LPI ($n = 100$)	CMEI Strasbourg ($n = 1721$)	CHS ($n = 650$)	CMEI Marseille ($n = 400$)	LHVP ($n = 170$)	H_2Q ($n = 715$)
Respiratory symptoms	63	10	61	20	–	78	–	–	60	29	–
Asthma	–	9	16	6	26	–	78	52	44	44	88
Ear, nose and throat symptoms	58	31	3	30	10	–	55	69	35	11	71
Conjunctivitis	–	13	2	3	23	1	30	18	10	2	7
Skin irritation	–	9	6	5	27	5	–	–	15	4	2
General symptoms[a]	46	21	5	9	7	16	–	–	–	3	–
Recurrent bronchitis	45	8	–	11	–	–	40	10	–	2	–
Chronic cough	–	24	–	16	43	–	35	8	6	2	–

Values are percentages

[a] Fatigue, myalgia, dizziness

Who performs the environmental inspection?

- Usually, a team includes 2 persons because of time constraints (the inspection will be shorter) and also because of safety issues. In the IFID and SAMI services, the inspection is performed by a specialized physician, and in LPI service by a biologist.

Who gets the result of the inspection?

- The family is given oral recommendations at the end of the inspection. Furthermore, a report including results of environmental sampling and a summary of the health hazards and recommendations are provided to both the family and the attending physician.

Who pays for the inspection?

- The IFID service is free when the inspection request comes from a physician who has validated training in environmental medicine. The Belgian services are free, apart for SAMI-Lux, which asks for an all-in price of €50. In France also, services are free of charge, apart from air sample analyses in CMEI, for which the patient has to pay. The French Ministry of Environment has recently decided to sponsor half the salary of 16 persons during 3 years in 3 or 4 administrative regions (http://www.ecologie.gouv.fr). In H_2Q [10], the cost of the visit is entirely supported by the family. The MHL service itself is free, but there is a small, symbolic, single contribution to laboratory costs (independent of number of samples).

Current achievements

Few data have been published in peer-review journals. Most data come from reports available on the web. Environmental health hazards identified by the various services are presented in Table 3.

Presence of moulds is the leading defect identified, followed by a high level of house dust mite allergens. Those 2 defects are often associated, because they are linked to excessive indoor humidity. Table 3 also lists non-respiratory risk factors possibly related to exposure to chemicals.

Efficacy of some services has been evaluated through interviews of families, without any objective measurement (Table 4). IFID and CRIPI concluded that 30% of families did not implement the recommendations. This percentage was 25% in the SAMI experience and 40% in the CHS service [13]. CMEI has led more detailed validation of the impact of home inspection on mite-allergen levels [18]. The CHS service has published a telephone evaluation about the implementation of recommendations provided following the home inspection [12]

Future strategies

Several aspects of these services deserve to be highlighted

- Firstly, several health hazards are generally identified in inspected dwellings. As an example, in 84% of dwellings inspected by the CHS service, several recommendations have been provided [13]. The same conclusion was drawn by the 2002 National French housing survey [19]: among the subgroup of dwellings with visible moulds, 23% had another structural defect, 13% had 2 other defects and 2% had 3 other defects. Similar observations were made in surveys performed in the 1990s in inner-city Boston [20]. Thus, the World Health Organization (WHO) recommended that home inspections should take into account a large array of housing hazards [21]. A pilot study has demonstrated the feasibility of this approach and its high efficacy to

Table 3 Main risk factors identified (a single dwelling may exhibit several risk factors)

	IFID ($n = 500$)	MHL ($n = 2,086$)	SAMI-Liège ($n = 484$)	SAMI-Lux ($n = 200$)	CRIPI ($n = 317$)	LPI Hainaut ($n = 100$)	CMEI ($n = 1721$)	CHS ($n = 650$)	LHVP ($n = 170$)	H_2Q ($n = 715$)
Moulds	60	13	66	43	40	51	35	74	68	79
House dust mites	–	–	24	10	–	34	92	23	70	59
VOC	20	19	7	29	13	1	10	10	–	–
Mineral fibres	–	2	7	7	–	–	1	–	–	–
Pesticides	–	23	2	2	–	2	1	–	–	–
Flame retardants	–	32	–	–	–	–	–	–	–	–
EMF	–	21	–	–	–	–	–	–	–	–

Values are percentages

Table 4 Evaluation of clinical status following environmental home inspection in patients who stated they had complied with advice provided by counsellor

	IFID	SAMI-Liège	SAMI-Lux	CRIPI	LPI	CMEI Marseille	CHS	H_2Q
Improvement	50	80	70	70	87	83	41	84
Steady state	50	20	30	30	13	17	59	16
Worsening	–	–	–	–	–	–	–	–

Values are percentages

control risk of domestic accidents [22]. However, in the large US housing hazards assessment protocols, not all hazards were taken into account [23]. Noteworthily, of 7 such US programs, only 2 took full account of risk of domestic accidents.

- Secondly, the relative importance of the various indoor health hazards identified was very similar in the various services. Excessive humidity, leading to mould and house dust mite proliferation, was ranked first by far. A recent meta-analysis demonstrated that living in a humid environment is related to a significant risk of developing de novo asthma and decreasing asthma control in asthmatic patients [24]. Such conclusions have also been reached in a large European collaborative epidemiological survey [25]. Exposure to hydrophilic moulds seems to present a greater health hazard than exposure to mesophilic moulds [26]. This result favours mould identification during housing inspection, which is not a common practice nowadays. The leading role of high humidity accounts for the fact that this issue is strongly connected to poor housing. Thus, management of such dwellings often involves a network including local councils, social workers and rehabilitation agencies.
- Thirdly, efficacy of such housing inspection for improving health has been poorly documented. In the field of house dust mites, a multi-centre French study [18] has demonstrated a larger reduction in mite-allergen levels following home inspection, compared with recommendations provided during an outpatient visit. The inner-city asthma study, a multi-centre US study including 1,000 asthmatic children, demonstrated a drop in symptomatic days following a home inspection which provided the family with tools for implementing a mite avoidance program and recommendations about exposure to passive smoking [27]. The Seattle-King County Healthy Homes project randomly assigned 274 low-income children with asthma to either a high- or low-intensity intervention program including measures to reduce allergen avoidance and improve housing conditions. Children in the high-intensity intervention group had a clinical benefit in terms of decreasing emergency visits and lower number of days with activity limitation [28]. Those two interventions studies led the Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention (CDC) (http://www.thecommunityguide.org) to recommend the use of home-based multi-component multi-trigger environmental intervention, at least in asthmatic children. The multi-centre US program [29] concluded that the intervention was cost-effective when the aim is to reduce asthma symptom days and the associated costs.

Conclusions

In future studies, it is necessary to perform cost–benefit analyses based on data collected in a standardized way by environmental inspection services. A follow-up visit including environmental measurements should be organised to obtain more objective data on efficacy.

References

1. Sheffer AL. Allergen avoidance to reduce asthma-related morbidity. N Engl J Med. 2004;35:1134–6.
2. Platts-Mills TA, Vaughan JW, Carter MC. The role of intervention in established allergy: avoidance of indoor allergens in the treatment of chronic allergic disease. J Allergy Clin Immunol. 2000;106:787–804.
3. National Heart, Lung, and Blood Institute. Expert panel report 3: Guidelines for the diagnosis and management of asthma: full report 2007. Available at: http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf.
4. Baden R. Conference on Environment and Health. Committee on the Environment, Agriculture and Local and Regional Affairs, Parliamentary Assembly, Council of Europe, 2008. http://www.assembly.coe.int.
5. CRIPI. Rapport d'activité 2002–2003, rapport technique IBGE, 2004.
6. Jonckheer P. Pollution intérieure. Protocole optimal de fonctionnement des services d'analyse des milieux intérieurs ou ambulances vertes. Rapport scientifique du projet européen Sandrine 2, 2002.
7. Ott M, de Blay F. L'éviction des allergènes: les services des conseillers médicaux en environnement intérieur. Rev Fr Allergol. 2006;46:330–3.
8. Fourgaut Gilles, « Eviction allergénique chez les patients asthmatiques allergiques aux acariens: rôle d'un conseiller en

environnement intérieur » Thèse de médecine 2000 Faculté de Médecine de Strasbourg.
9. Bex V, Mouilleseaux A, Bordenave L, Squinazi F. Environmental Audits in Ile-de-France. Eur Ann Allergy Clin Immunol. 2003;35:259–62.
10. Monteiro SF, da Mata P. House-dust mites and indoor environment in Portugal, Second WHO Housing & health symposium, Vilnius, 2004.
11. Speyer-Olette C, Rolland C, Vervloet D. Conseillère médicale en environnement intérieur. Bilan et suivi de cinq années d'exercice. Rev Fr Allerg. 2009;49:577–81.
12. Charpin-Kadouch C, Mouche JM, Quéralt J, Ercoli J, Chabbi S, Felipo R, et al. Housing and health counselling: preliminary result of a new medical referral system in France. Environ Res. 2007;103:149–53.
13. Charpin-Kadouch C, Mouche JM, Quéralt J, Ercoli J, Hugues B, Dumon H, Charpin D. Le Conseil habitat-santé dans la prise en charge des maladies allergiques respiratoires. Rev Mal Resp. 2008;25:821–8.
14. Van der Brempt X, Haddi E, Michel-Nguyen A, Fayon JP, Soler M, Charpin D, Vervloet D. Comparison of the Acarex-test with monoclonal antibodies for the quantification of mite-allergens. J Allergy Clin Immunol. 1991;87:130–2.
15. Porto JM. The use of cellophane tape in the diagnostic of Tinea versicolor. J Dermatol. 1953;21:229.
16. Santucci R, Meunier O, Ott M, Hermann F, Freyd A, de Blay F. Contamination fongique des habitations: bilan de 10 années d'analyses. Rev Fr Allergol Immunol Clin. 2007;47:402–8.
17. Kraemer JP, Ott M, Kopferschmitt MC, Meunier O, Bientz M, Pauli G, de Blay F. Apport d'un conseiller médical en environnement intérieur dans un cas d'aspergillose pulmonaire invasive. Rev Mal Respir. 2004;21:165–7.
18. de Blay F, Fourgaut G, Hedelin G, Vervloet D, Michel FB, Godard P, et al. Medical indoor environment councelor: role in the compliance with advice on mite-allergen avoidance and on mite-allergen exposure. Allergy. 2003;58:27–33.
19. Chesnel H. La qualité des logements. L'humidité est le défaut le plus fréquent. Insee première, No 971, 2004.
20. Hynes HP, Brugge D, Watts J, Lally J. Public health and the physical environment in Boston public housing: a community-based survey and action agenda. Plann Res. 2000;15:31–49.
21. Thomson H, Petticrew M. Is housing improvement a potential health improvement strategy? WHO Regional Office for Europe's Health Evidence Network (HEN 2005).
22. Klinzman S, Caravanos J, Belanoff C, Rothenberg I. A multi-hasard, multistrategy approach to home remediation. Result of a pilot study. Environ Res. 2005;99:294–306.
23. Jacobs DE. A qualitative review of housing hazard assessment protocols in the United States. Environ Res. 2006;102:13–21.
24. Fish WJ, Lei-Gomez Q, Mendell MJ. Meta-analyses of the associations of respiratory health effects with dampness and mold in homes. Indoor Air. 2007;17:284–96.
25. Antova T, Pattenden S, Brunekreef B, Rudnai P, Forastiere F, Lutman-Gibson H, et al. Exposure to indoor mould and children's respiratory health in the PATY study. J Epidemiol Comm Health. 2008;62:708–14.
26. Park JH, Cox-Ganser JM, Kreiss K, White SK, Rao CY. Hydrophilic fungi and ergosterol associated with respiratory illness in a water-damaged building. Environ Health Perspect. 2008;116:45–50.
27. Morgan WJ, Crain EF, Gruchalla RS, O'Connor GT, Kattan M, Evans R 3rd, et al. Inner-city Asthma Study Group: results of a home-based environmental intervention among children with asthma. N Engl J Med. 2004;351:1068–80.
28. Krieger JW, Takaro TK, Song L, Weaver M. The Seattle-King county healthy homes project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. Am J Public Health. 2005;95:652–9.
29. Kattan M, Steams SC, Crain EF, Stout JW, Gergen PJ, Evans R 3rd, et al. Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma. J Allergy Clin Immunol. 2005;117:1058–63.