

Domestic use of cleaning sprays and asthma activity in women

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MATERIAL AND METHODS

Population

The French EGEA study is a case control study which includes the examination of the cases' family members (relatives, spouses) (<http://cesp.vjf.inserm.fr/~egeanet/>). The design and the characteristics of the subjects from the first survey (EGEA1), conducted between 1991 and 1995 on 2047 subjects, have been described previously [1]. A follow-up of the subjects (EGEA2) was conducted (2003 to 2007) approximately twelve years later [2]. A short self-completed questionnaire was obtained from 92.2% of the initial population still alive at the second phase, and 77.1% of the subjects replied to the main questionnaire. A participant was classified with asthma if he/she was recruited as an asthmatic patient from chest clinics (with either four positive responses to standardized questions regarding asthma symptoms and diagnosis, or at least one positive response and a medical record review), or if he/she answered positively to one of the following standardized questions: i) Have you ever had attacks of breathlessness at rest with wheezing? ii) Have you ever had asthma attacks? [1]. Detailed questionnaires were recorded at the second examination for 1601 subjects, as described in detail previously [2]. Blood samples were collected for most of the participants and white blood cell counts and total serum IgE were measured, as described in detail previously [2, 3]. Lung function tests including methacholine challenge (not performed for those with FEV₁ <80% predicted or post-diluant FEV₁ <90%) were performed by using a standardized protocol. Bronchial responsiveness at 4 mg was evaluated by a decline of 20% in FEV₁ (PD20 ≤ 4mg). Skin prick tests were performed to 12 aeroallergens (cat, *Dermatophagoides pteronyssinus*, *Blattella germanica*, olive, birch, *Parietaria judaica*, timothy grass, ragweed pollen, *Aspergillus*, *Cladosporium herbarum*, *Alternaria tenuis*, cypress). Atopy (SPT+) was defined by the presence of at least 1 positive skin test (mean wheal diameter ≥ 3 mm than the negative control) among the 12 aeroallergens.

In the EGEA study, less men than women carried out home cleaning tasks (38% vs 77%) and used sprays (27% vs 48%) weekly (p<0.0001). Few men (7%) used at least two types of sprays as compared to women (21%). No associations were observed among men, between weekly home

cleaning (1.00[0.71-1.41]) and the use of sprays (0.90[0.60-1.34]) and current asthma or other asthma phenotypes, as previously reported in an abstract form [4].

Out of the 1601 examined subjects, 1546 were aged 18 years or more, including 781 women. Responses to specific domestic questionnaires regarding current tasks and exposures (past 12 months) were available for 733 women. The main objective of the present analysis is to study the association between current domestic exposure and current asthma activity. Fifty women with asthma in remission or with missing data for asthma symptoms were therefore excluded, and the present analysis was performed on 683 women (Figure E1).

Asthma symptom score

As previously described by Sunyer et al and Pekkanen et al [5, 6], an asthma symptom score was constructed independently of the asthma status. The asthma symptom score consisted of the sum of positive answers to 5 items from a standardized questionnaire : 1) breathless while wheezing in the last 12 months evaluated by two questions, 2) woken up with a feeling of chest tightness in the last 12 months, 3) attack of shortness of breath at rest in the last 12 months, 4) attack of shortness of breath after exercise in the last 12 months, 5) woken by attack of shortness of breath in the last 12 months. For the main analysis, a 3-level classification (0, 1, at least 2 symptoms) was considered to have approximately the same number of subjects in each category. Women with a score of one and at least two were compared to women with a score of zero, without taking asthma status into account. An analysis of the 5-level asthma symptom score has also been performed, using a negative binomial model to control for over dispersion, as previously used by Sunyer et al [5].

Current asthma

Current asthma was defined, in participants classified with asthma in at least one of the surveys, and the presence over the past 12 months of asthma attacks, an asthma treatment or respiratory symptoms as previously described [2, 7, 8]. Adult onset asthma (≥ 16 years old) was defined as previously [9].

Asthma control

Asthma control was assessed as described by Cazzoletti et al [7] and was already used in EGEA by Siroux et al [2], based on the GINA 2006-2010 guidelines, combining diurnal and nocturnal respiratory symptoms, asthma attacks, lung function, hospitalization for asthma and use of reliever medication. For the present analysis, women with current asthma were classified as poorly controlled (i.e. uncontrolled or partly controlled) or controlled, and compared to those with 'never asthma' (who had never had asthma).

Other asthma sub-phenotypes

Asthma severity was assessed, following the 2002-2006 GINA principles, as previously described in detail by de Marco et al [8] in the ECRHS survey, by combining data on the clinical features of the patients and the asthma treatment level at the time of examination. For the present analysis, women with current asthma were classified as 'severe' or 'not severe' (intermittent, mild and moderate) and compared to those with 'never asthma'.

The level of asthma symptoms in women with current asthma was assessed by taking into account the 3-level asthma symptom score. Women with current asthma and with one or no symptoms were considered as 'low symptom' (n=70), whereas those with at least two asthma symptoms were considered as 'high symptom' (n=174) and compared to those with 'never asthma'.

Taking lung function tests into account, two other asthma sub-phenotypes were defined. According to baseline FEV₁ based on Stanojevic et al. reference values [10], women with current asthma were classified as 'with' (< 80% of predicted values) or 'without low FEV₁'. Women with current asthma were classified as 'with' or 'without bronchial hyperresponsiveness' at 4 mg or 'with missing data'.

Four allergy and inflammation asthma sub-phenotypes have been defined, taking into account: a) SPT+: women with current asthma were classified as 'with SPT+' (at least 1 positive skin test) or 'without' and compared to those with 'never asthma' b) total IgE : as described previously [11], we used the cut-off point of 'total IgE \geq 100 international units (IU)/ml' to define high IgE level. Women with current asthma were classified as 'low' or 'high IgE level' (IgE \geq 100 IU/ml) c) eosinophil counts: as described previously [3], we used the cut-off point of ' \geq 250 eosinophils counts/mm³'. For

the present analysis, women with current asthma were classified as ‘eosinophilic pattern’ or ‘non-eosinophilic pattern’ ($< 250/\text{mm}^3$) d) neutrophil counts: as described previously [3], we used the cut-off point of ‘ > 5000 neutrophils counts/ mm^3 ’. Women with current asthma were classified as ‘neutrophilic pattern’ or ‘non-neutrophilic pattern’ ($\leq 5000/\text{mm}^3$). In all of the analyses on asthma subphenotypes, the women with each different asthma phenotype were compared to those without asthma.

Avoidance of polluted places

The avoidance of polluted places was evaluated by response to the four questions on this topic from the Asthma Quality-of-life Questionnaire (AQLQ). The AQLQ allows patients with asthma to record experiences in four domains (activity limitation, symptoms, environmental stimuli, emotional function) [12, 13]. The frequency of avoidance to polluted places, during the previous two weeks, is recorded on a 7-point scale from 1 (all of the time) to 7 (none of the time) for the following four questions [12] (close to questions number 11, 19, 25, 28): “In general, how much of the time during the last 2 weeks did you: 1) ‘Feel you had to avoid a situation or environment because of cigarette smoke?’; 2) ‘Feel you had to avoid a situation or environment because of dust?’; 3) ‘Avoid or limit going outside because of the weather or air pollution?’; 4) ‘Feel you had to avoid a situation or environment strong smells or perfume?’. A patient was classified as ‘without avoidance of polluted places’ if she reported ‘none of the time, 7’ or ‘hardly/any of the time, 6’ or ‘a little of the time, 5’ for each of these four questions, and in other cases she was classified as ‘with avoidance’.

Assessment of other variables

Domestic exposure patterns were defined through principal component analysis. This enables synthesized information from numerous variables to be obtained and is classically used to estimate dietary patterns in nutrition studies[14, 15]. We applied this method to summarize our 24 domestic exposure variables including 9 cleaning tasks and 15 cleaning agents (see appendix). An orthogonal transformation of axes (Varimax, SAS version 9.2) was performed to obtain a more interpretable structure. The number of factors to retain was determined using the eigenvalues graph. Principal component analysis (PCA) evidenced three domestic exposure patterns for the women. They were

labeled 'Essential tasks', 'Domestic wizard', and 'Chemical products' (Table 2). The first factor ('Essential tasks') was defined by domestic tasks or the use of cleaning products essential for common home cleaning. The second factor ('Domestic wizard') was defined by specific tasks to dust the home perfectly. The third factor ('Chemical products') was defined by the use of chemical products. The score obtained for each domestic exposure pattern was divided into tertiles in order to study the associations between exposure and asthma phenotypes.

Occupational history, diploma level and smoking habits were recorded by a standardized questionnaire during a face to face interview. Weight was measured during the clinical examination.

A quality management approach was followed for the EGEA data collection, and an International Organization for Standardization (ISO) 9001:2008 certification was obtained (<http://www.afaq.org/certification=262711141114>).

At both surveys, ethical approval to carry out the study was obtained from the relevant committees (Cochin Port-Royal Hospital, Paris, for the first survey (EGEA1); Necker Enfants-Malades Hospital, Paris, for the second survey (EGEA2)) and written consent was received from all participants.

Figure E1. Selection of the studied population

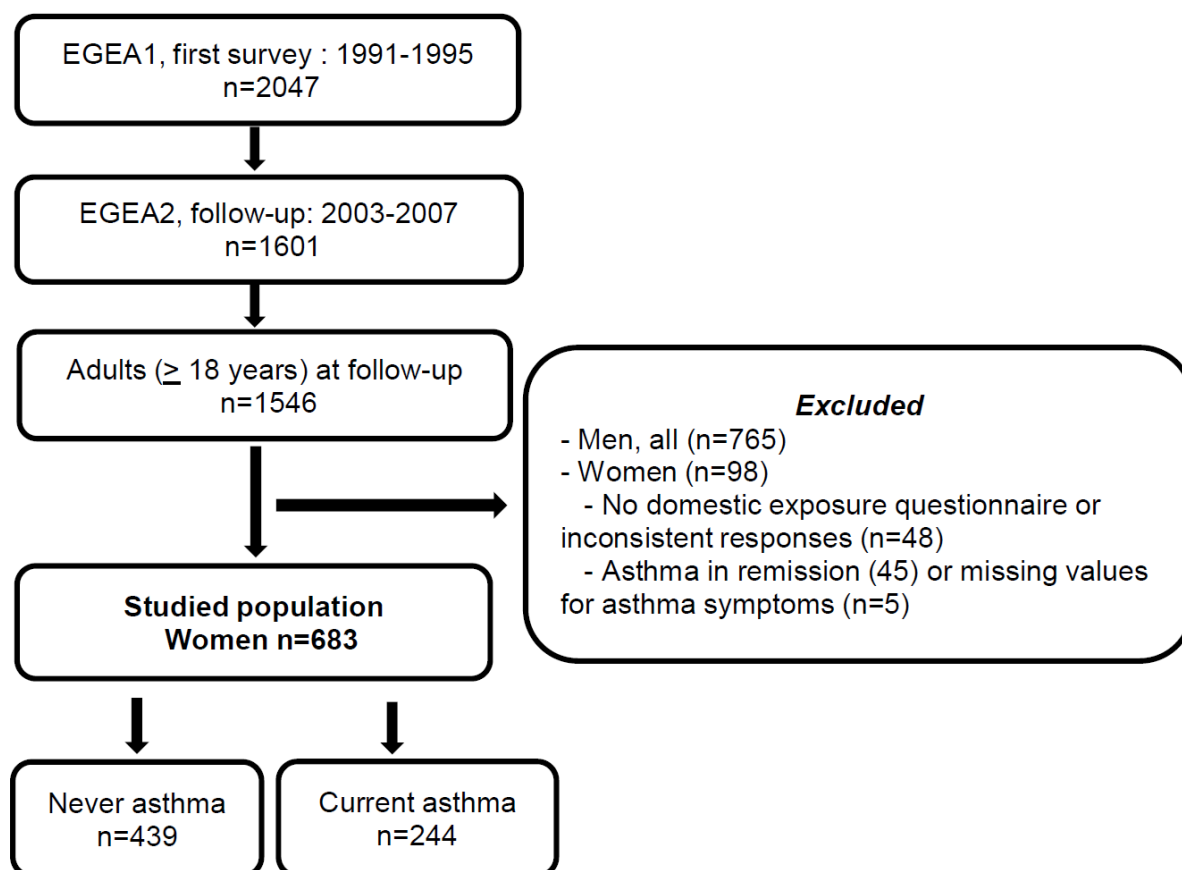


Table E1. Description of the population according to various phenotypes

	All women n=683	Asthma status		p value
		never n=439	current n=244	
Asthma onset				
Childhood (< 16 years old)	143 (60.9)	-	143 (60.9)	
Adulthood (\geq 16 years old)	92 (39.1)	-	92 (39.1)	
Asthma severity				
Not severe (intermittent to moderate)	161 (71.2)	-	161 (71.2)	
Severe persistent	65 (28.8)	-	65 (28.8)	
FEV₁, < 80% predicted				
No	575 (88.9)	387 (93.3)	188 (81.0)	< 0.0001
Yes	72 (11.1)	28 (6.7)	44 (19.0)	
PD20, \leq 4mg				
No	213 (32.9)	177 (42.0)	36 (15.9)	< 0.0001
Yes	199 (30.8)	97 (23.1)	102 (45.1)	
Missing (not performed)	235 (36.3)	147 (34.9)	88 (39.0)	
SPT+				
No	299 (49.3)	251 (63.7)	48 (22.5)	< 0.0001
Yes	308 (50.7)	143 (36.3)	165 (77.5)	
IgE, \geq 100 IU/ml				
No	423 (65.1)	317 (75.8)	106 (45.7)	< 0.0001
Yes	227 (34.9)	101 (24.2)	126 (54.3)	
Eosinophilia (\geq 250/mm³)				
No	500 (77.0)	358 (86.1)	142 (60.9)	< 0.0001
Yes	149 (23.0)	58 (13.9)	91 (39.1)	
Neutrophil (> 5000/mm³)				
No	509 (78.7)	333 (80.4)	176 (75.5)	ns
Yes	138 (21.3)	81 (19.6)	57 (24.5)	

In women with current asthma, there were missing values (n) for age of asthma onset (9), asthma severity (18), FEV₁ (12), PD20 (18), atopy (31), IgE (12), eosinophil (11), and neutrophil (11).

In women without asthma, there were missing values (n) for FEV₁ (24), PD20 (18), atopy (45), IgE (21), eosinophil (23) and neutrophil (25).

Appendix : specific domestic questionnaire

AT HOME

16. On how many days a week did you perform the following tasks? (in the last 12 months)?

	Number of days per week			
	Never	<1 d	1-3 d	4-7 d
a) Cleaning the house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Washing clothes by hand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Washing clothes by machine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Cooking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17. On how many days a week did you perform the following cleaning tasks? (in the last 12 months)?

a) Dusting, sweeping, hoovering, rug beating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Mopping, wet cleaning, damp wiping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Cleaning the toilet bowl	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Polishing, waxing, shampooing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Cleaning windows or mirrors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Cleaning the kitchen (not including dish washing)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. On how many days a week did you use the following cleaning products? (in the last 12 months)?

a) Washing powders (detergents)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Liquid multi-use cleaning products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Polishes, waxes (floor, furniture)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Bleach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Ammoniac	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Decalcifiers, acids (liquid scale removers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Solvents, stain removers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Perfumed or scented cleaning products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) Other cleaning products, specify:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

19. On how many days a week did you use the following sprays (in the last 12 months)?

a) Furniture sprays	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Glass cleaning sprays (windows, mirrors)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Sprays for carpets, rugs, or curtains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Sprays for mopping the floor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Oven sprays	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Ironing sprays	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Air refreshing sprays	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Other sprays, specify:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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