Brief communication

Pet allergen levels in homes in Ghana and the United Kingdom

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The frequency of cat and/or dog ownership in Ghana is comparable to that in the United Kingdom (~50%). However, in Ghanaian communities pets are predominantly kept outdoors. Levels of pet allergens (Fel d 1 and Can f 1) in 100 Ghanaian homes (49 without pets) were compared with levels in 410 homes in the United Kingdom (258 without pets). Homes with pets in the United Kingdom contained much higher allergen levels than homes with pets in Ghana (for Fel d 1: mean difference, 275-fold; 95% CI, 129-fold to 594-fold; $P < .0001$; for Can f 1: mean difference, 75-fold; 95% CI, 33-fold to 169-fold; $P < .0001$). Homes without cats in the United Kingdom contained significantly higher levels of Fel d 1 than homes with cats in Ghana (mean difference, 3.7-fold; 95% CI, 2.0-fold to 7.2-fold; $P < .0001$). In the United Kingdom, homes with dogs contained 75-fold (95% CI, 47-fold to 139-fold) more Can f 1 than homes without dogs, whereas in Ghana, homes with dogs contained 3.1-fold (95% CI, 1.5-fold to 6.1-fold; $P = .003$) more Can f 1 than homes without dogs. In the United Kingdom, homes with cats contained 77-fold more Fel d 1 (95% CI, 46-fold to 129-fold; $P < .0001$) than homes without cats; there was no difference in cat allergen levels between homes with cats and homes without cats in Ghana. In conclusion, levels of pet allergens in Ghanaian homes with pets were (1) between 75-fold (dog) and 275-fold (cat) lower than levels in homes with pets in the United Kingdom and (2) lower than or comparable to levels in homes without pets in the United Kingdom. (J Allergy Clin Immunol 2001;108:463-5.)

Key words: *Asthma, risk factors, allergens, Africa*

Recent studies highlight the importance of sensitization to cat and dog allergens in asthma in developed countries with high rates of pet ownership.[1] The situation in developing countries is markedly different. We have reported that the prevalence of exercise-induced bronchospasm and atopy was twice as common in a rich urban population in Ghana than in children from poor urban and rural communities, with a strikingly low prevalence of allergies to cat and dog (both <1%)[2] despite apparently high rates of pet ownership.[3]

Abbreviations used
Can f 1: *Canis familiaris* group 1 allergen
Fel d 1: *Felis domesticus* group 1 allergen

Children who are exposed to high levels of cat allergen might have a modified T_H2 response characterized by the presence of IgG_4 antibody to cat protein without IgE response,[4] which might explain the reported decreased risk of asthma in children living in homes with cats.[5] It is possible that within any community, moderate passive exposure (in homes without pets and in public places) results in significant sensitization, with very high levels inducing tolerance and very low levels not leading to IgE response. Therefore, a clear understanding of allergen levels within each community and of the differences between communities might be essential.

The aim of this study was to measure the levels of major cat and dog allergens in homes with pets and homes without pets in a developing country (Ghana) and compare them with the levels in a developed country (the United Kingdom).

METHODS

The study was carried out in Kumasi, Ghana (estimated population, ~1 million) and Manchester, United Kingdom. Levels of *Canis familiaris* group 1 allergen (Can f 1) and *Felis domesticus* group 1 allergen (Fel d 1) in 100 Ghanaian homes (49 without pets, 16 with cats only, 15 with dogs only, and 20 with cats and dogs) were compared with those in 410 homes in the United Kingdom (258 without pets, 75 with cats only, 64 with dogs only, and 13 with cats and dogs). Homes in Kumasi were visited as a part of a study on risk factors for asthma in Ghanaian children.[3] A random sample of 50 children with asthma was recruited from the Komfo Anokye Hospital, and for each case, 1 age- and sex-matched control subject without respiratory symptoms was randomly selected from a local school.

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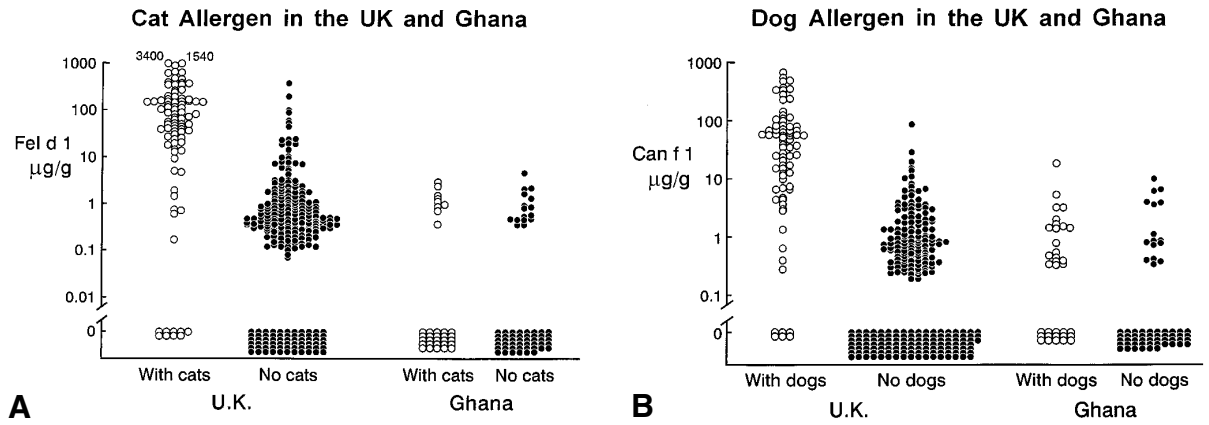

FIG 1. Cat (**A**) and dog (**B**) allergen levels in 100 Ghanaian homes and 410 homes in the United Kingdom. Two values (3400 and 1540 mg Fel d 1/g) are outliers.

TABLE I. Cat and dog allergen levels in homes in the United Kingdom and Ghana

	Allergen level (µg/g): GM (95% CI)	
	Fel d 1	**Can f 1**
No cats		
UK (N = 322)	0.43 (0.35-0.53)	—
Ghana (N = 64)	0.10 (0.07-0.14)	—
No dogs		
UK (N = 333)	—	0.25 (0.20-0.30)
Ghana (N = 65)	—	0.12 (0.08-0.18)
Homes with cats		
UK (N = 88)	31.7 (17.6-57.0)	—
Ghana (N = 36)	0.11 (0.07-0.19)	—
Homes with dogs		
UK (N = 77)	—	21.2 (12.3-36.6)
Ghana (N = 35)	—	0.28 (0.15-0.52)

GM, Geometric mean; *UK,* United Kingdom.

With respect to social and environmental variables, subjects were matched with the general population. Homes in Manchester were visited as a part of the Manchester Asthma and Allergy Study[6] over the same period. Identical questionnaires on pet ownership and housing characteristics and identical dust sampling procedures were used in the 2 locations.

Dust collection was done over a 1-m^2 area of bedding for 2 minutes through use of a vacuum cleaner (airflow, 45 L/s), as previously described.[7,8] For 4 homes in Ghana where a power supply was not available, subjects were asked to bring their bedding (foam mattress, blankets, sheets, and pillows) to the hospital for samples to be taken. Samples were stored at –20°C until extraction. One hundred milligrams of fine dust was extracted with 2 mL of borate-buffered saline solution with 0.1% Tween 20. Can f 1 and Fel d 1 were assayed through use of mAb-based ELISAs.[7,8] Extraction and assays were performed at the same laboratory (United Kingdom) at the same time.

The data were analyzed through use of SPSS software (version 8.0). Allergen data followed a log-normal distribution; the results are thus presented as geometric means and 95% CIs. Allergen data were compared through use of the Student *t* test.

RESULTS

Of 100 visited homes in Ghana, 25 were compound houses, 38 were bungalows, and 37 were flats (well matched with housing in the general population). Similarly, in type and age, the visited homes in the United Kingdom reflected those of the general population (eg, 48.4% were built before 1940, 22.6% between 1941 and 1960, 16.6% between 1961 and 1980, and 12.4% after 1981). In all, 91 of the 100 homes in Ghana and 385 (94%) of the 410 homes in the United Kingdom had carpeted bedrooms. Similar proportions of homes were in urban and suburban areas (50 vs 50 in Ghana, 194 vs 216 in the United Kingdom).

Levels of Fel d 1 and Can f 1 in 100 Ghanaian homes and 410 homes in the United Kingdom are presented in Fig 1.

In the United Kingdom, homes with pets contained much higher allergen levels than did homes with pets in Ghana (for Fel d 1: mean difference, 275-fold; 95% CI, 129-fold to 594-fold; $P < .0001$; for Can f 1: mean difference, 75-fold, 95% CI, 33-fold to 169-fold; $P < .0001$).

In the United Kingdom, homes without cats contained significantly higher levels of cat allergen than did homes with cats in Ghana (mean difference, 3.7-fold; 95% CI, 2.0-fold to 7.2-fold; $P < .0001$; Table I). For the dog allergen Can f 1, there was no difference between homes without dogs in the United Kingdom and homes with dogs in Ghana.

Differences in allergen levels between homes with pets and homes without pets were much greater in the United Kingdom than in Ghana. In the United Kingdom, homes with dogs contained 75-fold (95% CI, 47-fold to 139-fold) more Can f 1 than homes without dogs, whereas in Ghana, the difference between homes with dogs and homes without dogs was 3.1-fold (95% CI, 1.5-fold to 6.1-fold; $P = .003$). There was no significant difference in cat allergen levels between homes with cats and homes without cats in Ghana. In contrast, in the United Kingdom, homes with cats contained 77-fold more Fel d 1 (95% CI, 46-fold to 129-fold; $P < .0001$) than homes without cats.

DISCUSSION

In the current study, the frequency of cat and/or dog ownership in urban Ghana, as assessed by the standard

questionnaire, was comparable to that in the United Kingdom and other developed countries (~50%) and is similar to the frequency reported in our previous study of more than 1000 schoolchildren.[3] Although reported pet ownership is high, the reasons for keeping pets in Ghanaian communities are different from those in Western countries. In Ghana, dogs are usually kept to ward off intruders and cats are kept to control rodents. Pets are predominantly kept outdoors, and people live much less closely with them than in the developed countries. Consequently, we have found very low indoor pet allergen levels (eg, the level of Fel d 1 was significantly lower in homes of Ghanaian cat-owners than in homes without cats in the United Kingdom).

Houses in both locations were representative of the housing found in their respective areas. Most of the houses in Kumasi are built of cement and roofed with corrugated iron, aluminum, or zinc sheets. A compound house is a large single-story or multistory house that has an enclosed compound and is occupied by a group of families. Each family may hold 1 or 2 rooms of the house; toilet, bath, and kitchen facilities are usually shared. More affluent families live in flats or bungalows, usually with 1 to 3 bedrooms.

Pet allergens in the developed countries are ubiquitous, and passive exposure in homes without pets or outside the domestic environment can lead to specific IgE responses in childhood and adolescence.[7,8] A recent report has indirectly confirmed the potential importance of passive exposure, finding a significant correlation between community prevalence of cat ownership and community prevalence of sensitization to cats, overall prevalence of respiratory symptoms, physician-diagnosed asthma, and current asthma medication.[9] This is indirectly confirmed in studies comparing populations with same genetic background living in different conditions (eg, in traditional Chinese communities pet ownership is rare and asthma is not associated with pet allergy, whereas in urban Hong Kong, where pet ownership is much more common, being sensitized to animals represents a significant risk factor for asthma[10]).

In conclusion, levels of cat allergen are considerably lower in homes of Ghanaian cat owners than in homes without cats in the United Kingdom. Despite similar rates of pet ownership, levels of pet allergens were between 75-fold (dog) and 275-fold (cat) lower in Ghanaian homes with pets than homes with pets in the United Kingdom, and levels in Ghanaian homes with pets were lower than or comparable to levels in United Kingdom homes without pets. These data suggest that similar proportions of pet ownership in different countries do not equate to similar levels of exposure to allergen and that pet ownership rates are not a surrogate for allergen exposure rates. Measurement of Fel d 1 and Can f 1 is essential to predict individual exposure.

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