# Ladybug hypersensitivity among residents of homes infested with ladybugs in Kentucky

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**Background:** There have been isolated case reports of hypersensitivity to the ladybug species *Harmonia axyridis*. Entomologists now report a rapid increase in ladybug numbers, giving rise to increasing complaints of residential infestations.

**Objectives:** To determine whether ladybug infestation of homes causes hypersensitivity among residents and to estimate the prevalence of self-reported ladybug allergy in this population.

**Methods:** This pilot observational study was conducted using an anonymous survey.

**Results:** The participation rate was 59% (99/167). The incidence of self-reported allergy symptoms in this population was 77% (95% confidence interval [CI], 67%–85%). The prevalence of self-reported ladybug allergy was 50% (95% CI, 39%–60%). Of all the respondents, 19% (95% CI, 12%–28%) reported allergy symptoms on direct contact with ladybugs and 31% (95% CI, 22%–41%) reported the use of extra allergy medications during times of infestation. The correlation between worsening of allergy symptoms and time of infestation was significant for spring, fall, and winter infestations ($P = .02$, $P = .001$, and $P < .001$, respectively).

**Conclusions:** To our knowledge, this is the first study to estimate the prevalence of ladybug hypersensitivity, which was found to be 50% by self-report among people with home infestations. These results suggest that the ladybug could be a significant cause of respiratory allergy in heavily infested homes. Further studies using diagnostic testing to confirm allergy are now indicated. We recommend that patients with spring, fall, and winter allergies be asked about ladybug infestation and that ladybug reagents be made available for diagnostic testing.

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## INTRODUCTION

Inhalant allergens arising from insects such as flies, beetles, moths, cockroaches, and mites have been well described in the literature.[1] In the past few years there have been several case reports suggesting that an exotic species of ladybug, the Asian lady beetle (*Harmonia axyridis*), is a source of inhalant allergens as well. These case reports[2–7] describe 9 patients with allergic respiratory symptoms, including rhinitis, conjunctivitis, and asthma, related to exposure to ladybugs. Most of these patients had positive skin prick test reactions to ladybug extract. When IgE immunoblotting was performed, the most common bands were at 16.6, 14, and 30 kDa. The ladybug allergens have been shown to be present in the whole-body extract, surface washings, and blood.[8] A recent study[9] identified 12 additional patients with a history of ladybug exposure who were found to have positive skin prick test reactions to ladybug whole-body extract.

This species of ladybug was first introduced from Asia in the 1970s and early 1980s in some eastern and southeastern states to control aphids and other agricultural pests. However, they have now spread over most of the country. During fall they come inside houses to hibernate (Fig 1). They stay indoors until spring, when with the advent of warmer weather

Figure 1. Ladybugs hibernating. Photograph provided by Hobert L. Pence, MD.

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they go outside again. In past years, pest control companies have received an increasing number of complaints about ladybug infestations (Fig 2). There have been no studies to date, to our knowledge, to determine the prevalence of ladybug hypersensitivity.

## METHODS

### *Sampling Method*

A total of 167 surveys were mailed to residents of houses infested with ladybugs in Kentucky. These residences were identified with the help of the Department of Entomology at the University of Kentucky. The surveys were mailed between February and April 2005. This timeframe was chosen to coincide with the end of ladybug infestation season to reduce recall bias and enhance the response rate.

### *Survey Development*

Respondents completed a 17-question survey developed by the authors requiring "yes" or "no" answers or free response. These questions related to the location and description of their house, the duration and timing of ladybug infestation, the nature and timing of allergy symptoms, the presence of symptoms with direct contact with ladybugs, the use of extra allergy medication at times of infestation, measures taken to get rid of the ladybugs, and family history of allergies. The case definition for ladybug allergy was based on self-report of at least 2 convincing symptoms, including sneezing, runny nose, itchy eyes, cough, shortness of breath, wheezing, and rash, when occurring in proximity to or on contact with ladybugs. The survey was anonymous and contained no identifiers of personal health information. Consent was included in the preamble to the survey. This study was reviewed and approved by the institutional review board at the University of Louisville.

### *Data Analysis*

Returning surveys were analyzed using descriptive statistics and the binomial test for 95% confidence intervals (CIs), cross-tabulations, the $\chi^2$ or Fisher exact test for differences in proportions between groups, and the Wilcoxon rank sum test. Statistical software (Stata; StataCorp, College Station, TX) was used for all analyses. Prevalence is reported herein as the number of individuals who met the case definition for ladybug allergy divided by the total population at risk by virtue of living in a ladybug-infested house.

Figure 2. Ladybug infestation. Photograph provided by Michael F. Potter, PhD.

## RESULTS

Completed surveys were received from 99 individuals (response rate, 59%). Of all the respondents, 77% (95% CI, 67%–85%) claimed to have allergies, with symptoms being present year-round in 18%. The prevalence of self-reported ladybug allergy (defined by their reporting worsening of symptoms when ladybugs infested their house) was 50% (95% CI, 39%–60%). Season-specific breakdown of the prevalence of allergic symptoms was as follows: spring, 60%; summer, 27%; fall, 55%; and winter, 36%. Ladybugs were noted in the house in spring by 60% of respondents, in summer by 32%, in fall by 80%, and in winter by 67%. Cross-tabulations comparing the presence of ladybugs in the home and worsening of allergy symptoms showed that of respondents reporting springtime infestation, 70% had worsening of their symptoms compared with 45% of those whose houses were not infested in the spring ($P = .021$, Fisher exact test). In fall, 63% of the infested group reported worsening of symptoms compared with 20% of the noninfested group ($P = .001$, Fisher exact test). In winter, 52% of the infested group had worsening of symptoms compared with only 6% of the noninfested group ($P < .001$, Fisher exact test). Worsening of symptoms was also noted to be higher in the infested group in summer (34% vs 24%), but this was not statistically significant ($P = .34$). Of the persons reporting year-round ladybug infestations, 89% had worsening of symptoms in fall and winter, 67% in spring, and 44% in summer. Of all the respondents, 19% (95% CI, 12%–28%) reported symptoms on direct contact with ladybugs, with itchy eyes (12 of 19 respondents), runny nose (11 of 19), sneezing (9 of 19), and rash (8 of 19) being the most common. People reporting worsening of symptoms with ladybug exposure reported a higher number of ladybugs in their house (Wilcoxon rank sum test $Z = 2.457$; $P = .01$). Of the 49 participants reporting worsening of symptoms at times of infestation, 63% (95% CI, 48%–77%) indicated the use of extra allergy medication during times of ladybug infestation (31% [95% CI, 22%–41%] of all 99 respondents).

## DISCUSSION

This study identifies exposure to ladybugs as an environmental and occupational risk factor for allergies. Table 1 summarizes the clinical features of the first 9 cases reported in the literature. Of these, 7 patients were exposed at home. The remaining 2 were exposed at work, thus establishing this as an occupational hazard to people who breed and distribute these ladybugs to farmers. It seems to be an important source of indoor allergens during times of infestations. Although

Table 1. The First 9 Patients With Ladybug Hypersensitivity*

| Source | Patient No./sex/age, y | Exposure | Symptoms | IgE immunoblot, kDa |
|---|---|---|---|---|
| Yarbrough et al[3] | 1/M/48 | Home | Rhinitis, conjunctivitis | 16.6 |
| Yarbrough et al[3] | 2/F/56 | Home | Rhinitis | 16.6 and 30 |
| Pence et al[4] | 3/M/40 | Home | Rhinitis, asthma, conjunctivitis | 14 and 31 |
| Kagen and Muthiah[5] | 4/F/40 | Home | Rhinitis, asthma, conjunctivitis | 14 and 30 |
| Glass et al[6] | 5/M/46 | Home | Rhinitis, asthma | Not done |
| Glass et al[6] | 6/F/42 | Home | Rhinitis | Not done |
| Glass et al[6] | 7/F/22 | Work | Rhinitis, conjunctivitis | Not done |
| Magnan et al[7] | 8/M/67 | Work | Asthma | 16.6 and 30 |
| Ray and Pence[2] | 9/F/36 | Home | Rhinitis, asthma | Not done |

* Revised from Ray and Pence.[2]

ladybug allergens have been thought of as aeroallergens to date, 19% of the respondents mentioned symptoms on direct contact, with 8 reporting rash.

There are several limitations to this study. Regarding survey methods, overrepresentation of allergic individuals is likely because they are more likely to respond to the survey, giving rise to self-selection bias. The participants herein represent a convenience sample rather than a true random sample. Also, households with multiple individuals allergic to ladybugs were not taken into account because single surveys were mailed to these houses. Only the individuals responding to the survey were counted toward the numerator and denominator for prevalence rate calculations. A major limitation of this study is that it did not corroborate history with diagnostic testing. It was clearly not practical in this study to perform diagnostic testing on individuals from the general population in the absence of convincing evidence about the extent of this problem and also because the survey was anonymous. Although we relied on self-report, we established criteria for convincing symptoms as described previously. This approach has been used in the past for food allergies, such as with peanut and tree nut allergy,[10,11] and has been shown to have a high level of accuracy (97%).[11] Last, we did not address nonallergic reactions to ladybugs, which could have been a confounding factor. These limitations aside, it is important to understand that this was a pilot study with the purpose of determining whether there was a significant prevalence of ladybug hypersensitivity warranting further, larger, more extensive studies using diagnostic tests. As suggested by these results, this indeed is the case. Even if we were to dismiss the self-report of worsening symptoms on ladybug exposure seen in 50% of the respondents, the prevalence of allergic symptoms on contact with ladybugs (seen in 19% of the respondents) and the requirement of extra allergy medications at times of infestation (seen in 31% of the respondents) serve to highlight the significance of this problem. Many cases of ladybug hypersensitivity go undiagnosed in the absence of proper recognition. Even when suspected, there is no commercially available ladybug extract to aid diagnosis. Some clinicians and researchers have resorted to preparing their own extract.[9,12] Goetz[12] uses his self-prepared ladybug extract in aeroallergen skin test panels. His retrospective medical record review study revealed some interesting findings. Ladybug sensitization was found to be positive in 21% of the tested patients, which was comparable to cat (24%) and cockroach (27%). Also, there was high skin test concordance between ladybug and cockroach.[12] A cross-reactivity between ladybug and cockroach (*Blatella germanica*) proteins has been suggested by another study[9] that identified 3 allergenic proteins (10, 40, and 55 kDa). At least 1 company, Greer Laboratories (Lenoir, NC), has been working on in vivo and in vitro testing for diagnosing hypersensitivity, but it does not offer a commercially available product at this time (Robert Esch, PhD, Greer Laboratories, personal communication, 2006).

Atopic diseases have increased in recent years,[13] with the hygiene hypothesis being one of the contending explanations.[14] It is interesting to consider the role of importing new plants and animals (such as ladybugs) that may serve as new sources of allergens. Entomologists report that *H axyridis* is gradually replacing the native species of ladybugs secondary to their strong intraguild predation habits whereby larvae of *H axyridis* prey on larvae of local species.[15] This poses a potential health hazard. The biological pest control benefits of these ladybugs need to be weighed against the risk of allergies.

We conclude that the prevalence of ladybug hypersensitivity is significant enough to warrant more research in this area. This may well be a more significant problem than the current medical literature indicates. Allergists and other health care professionals should be aware of this potential cause of seasonal allergies. Reagents for in vivo and in vitro tests should be made available to help diagnose this disorder. *Harmonia axyridis* infestation poses a potential health threat as it continues to spread throughout the United States.

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