

Prevalence of occupational allergy due to live fish bait

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Summary

Background Larvae of insects and worms, used as live fish bait (LFB), are a common source of allergy in anglers and occupationally exposed workers, but the prevalence and predictors have not yet been investigated.

Objective This study assessed the prevalence and associated factors of occupational allergy in workers exposed to LFB.

Methods We assessed the prevalence of sensitization to LFB and work-related symptoms (WRS) in 76 workers occupationally exposed to it. All workers completed a case history questionnaire and underwent skin prick tests (SPT) for common aeroallergens and bluebottle (*Calliphora vomitoria*), bee moth (*Galleria mellonella*), mealworm (*Tenebrio molitor*), and gusano rojo (*Cilecomadia moorei*). Specific IgE were tested in 64 subjects. Two-thirds of the workers had a high level of LFB exposure.

Results Sensitization to LFB was found in 24 workers (31.6%). Seven subjects (9.2%) reported WRS (asthma in 3, rhinoconjunctivitis in 5, and contact urticaria in 1), and 5 were positive for SPT and serum IgE to one or more LFB extracts. One was also exposed to LFB while fishing. Sensitization to LFB extracts and WRS were strongly associated (Odds Ratio = 6.6, $P < 0.05$). The 7 subjects with WRS had been exposed longer than asymptomatic subjects with positive skin tests to LFB ($P < 0.05$). No differences in sex, age, smoking habit, duration or level of exposure, and atopy were detected in symptomatic or in sensitized subjects, compared with normal workers.

Conclusion Sensitization to LFB and WRS are relatively frequent in occupationally exposed workers. No associated factors of occupational allergy to LFB could be detected.

Keywords asthma, immunoglobulin E, live fish bait, moths, occupational diseases, occupational exposure, prevalence, rhinitis, *Tenebrio*, urticaria

Submitted 2 August 2002; revised 28 November 2002; accepted 3 January 2003

Introduction

'There were many roadside stores as well, more than you would have thought such a poor and scattered populace could support, and they all had big signs announcing a motley of commodities: GAS, FIREWORKS, FRIED CHICKEN, LIVE BAIT. I wondered just how hungry I would have to be to eat fried chicken prepared by a man who also dealt in live bait' [1].

Occupational allergy to insects is a frequent health problem among workers handling insects and has been described in entomological research [2]. Indeed, respiratory symptoms were first described over three centuries ago by Bernardino Ramazzini [3]. Major sources of allergens are insect excreta and secretions. Larvae of insects and worms, used as fish bait, are a common source of allergy in anglers [4] and occupationally exposed workers [5]. We have described asthma, rhinoconjunctivitis, and contact urticaria caused by greenbottle (*Lucilia caesar*), bee moth (*Galleria mellonella*) or mealworm (*Tenebrio molitor*) in anglers and workers employed in fish bait farms [4].

The degree of exposure, atopy, and specific IgE are associated factors for work-related asthma [2, 4] and rhinitis [6] in several occupational settings, but their association with live fish bait (LFB) allergy have yet to be investigated. We studied prevalence and associated factors of occupational allergy in 76 workers exposed to LFB.

Methods

Subjects

All 50 workers in eight LFB farms (five bluebottle (*Calliphora vomitoria*), two bee moth, and one mealworm) agreed to participate in this study. Fish bait farming can be outlined in three stages. Female insects and worms are fed in a high temperature to stress and drive them to a high egg deposition. Secondly, eggs are put in a nutrient medium to stimulate hatching and larvae development. Larvae are then sifted, cleaned, stored and sold. In the last step exposure to insect excreta and secretions is greatest. All workers are involved in all stages.

In addition, eight of the 15 local retailers exposed to greenbottle, bee moth, mealworm, and gusano rojo (*Cilecomadia moorei*) agreed to participate in the study as did all 18 laboratory workers at the Institute of Agrarian Entomology,

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Presented in part at the 2000 ALA/ATS International Conference.

University of Perugia, who were exposed to bee moth and mealworm.

Mean age of the 76 participants was 41.4 years (SD 12.6); 52 (68.4%) were males; smokers, ex-smokers and non-smokers were evenly distributed; 10 subjects had a history of asthma or rhinoconjunctivitis; 14 (18.4%) had positive skin prick tests (SPT) to common aeroallergens. Direct exposure to LFB was high (> 5 h/day) in 50 subjects (66.0%), moderate (2–5 h/day) in 15 (20.0%), and low (< 2 h/day) in 11 (14.0%). 60.5% of subjects were exposed to bluebottle, 50.0% to mealworm, 30.3% to bee moth and 10.5% to gusano rojo.

Diagnostic procedures

All 76 subjects completed a physician-administered study-specific questionnaire, containing questions about job, duration, type, and degree of exposure, smoking habits, family history of atopy and work-related symptoms (WRS). WRS were defined as skin, upper and/or lower airways symptoms occurring at work during exposure to LFB, with improvement or remission on weekends or vacation.

All subjects underwent SPT for eight common aeroallergens (grass, *Parietaria*, olive, cypress, *Dermatophagoides pteronyssinus*, cat, dog, and rabbit dander) and for bluebottle, bee moth, mealworm, gusano rojo extracts, plus a negative (normal saline) and a positive control (histamine 10 mg/mL). SPT were performed as recommended by the EAACI position paper [7]. SPT to the four LFB extracts were negative in eight healthy controls.

Specific IgE to bluebottle, bee moth, mealworm, and gusano rojo were tested in 64 workers (84.2%). The other 12 refused to undergo the blood test.

Statistical analysis

Data were analysed using the Statistical Analysis System (SAS) package for PC (Version 6, SAS Institute, Cary, NC, USA). Values for continuous variables are expressed as the mean $\pm$ SD. The Kruskal–Wallis and the chi-square tests were used to examine differences between subjects with WRS, asymptomatic subjects with positive skin tests to LFB, and normal subjects. Differences were considered significant at $P < 0.05$.

Results

Seven males (9.2%) reported WRS. One, an angler, was also exposed to LFB while fishing. WRS were asthma in three subjects (3.9%), rhinoconjunctivitis in five (6.6%), and contact urticaria in one (1.3%). Table 1 summarizes the characteristics and immunologic test results of the seven subjects with WRS. Two workers claimed WRS were due to bluebottle, three thought they were due to bee moth, and two to mealworm. SPT and serum IgE were negative in two subjects with rhinitis due to bee moth. Four subjects had positive SPT to three or four LFB extracts simultaneously. Exposure to LFB was moderate to high in 6/7 workers, with the other having low exposure but a history of non-occupational atopic asthma and rhinoconjunctivitis.

Polysensitizations to two or more LFB extracts were slightly more common in SPT than in serum IgE, which tended to be more specifically related to LFB-induced symptoms (Table 1).

SPT to LFB extracts were positive in 24 subjects (31.6%) (5/7 with WRS and 19 asymptomatic subjects) ($P < 0.05$). Exposure was more frequent in bluebottle and mealworm, while sensitization was more frequent to bluebottle and bee moth than to mealworm and gusano rojo in subjects with WRS and in asymptomatic subjects (Table 2). There was a strong association between sensitization to LFB extracts and WRS (with Odds Ratio of 6.6, $P < 0.05$ based on Fisher exact test).

The 19 asymptomatic subjects with positive SPT to LFB had a shorter duration of LFB exposure ($P < 0.05$) than subjects with WRS. No other statistical differences were found. No differences in sex, smoking habit, degree of exposure, and atopy were detected in symptomatic or in sensitized subjects, compared with normal subjects.

Discussion

This cross-sectional study has shown symptoms and sensitization in workers occupationally exposed to LFB. The prevalence of WRS and sensitization seems somewhat lower than is found in other studies on workers occupationally exposed to insects [2, 6], size of although the our study may hamper a valid comparison. Lower levels of occupational exposure in LFB breeders, retailers, and laboratory workers may account for the discrepancy, but this hypothesis needs to be confirmed by environmental tests. Allergens derived from other insects may have a greater potency than LFB [2].

There have been few detailed biochemical studies of LFB allergens. Major mealworm allergens have been identified as protein fractions of 32 and 52 kDa [8]. We have recently studied two other LFB extracts (paper submitted) and immunoblotting analyses of the allergens from bee moth and greenbottle show major allergens at 65 kDa and at 42 and 84 kDa, respectively, without cross-reactivity between them. Consequently, sensitization to more than one occupational allergen is due, not to cross-reactivity, but probably to simultaneous exposure to several LFB extracts. A more unlikely explanation is false positive results in allergy testing.

In spite of the small number of subjects with WRS, LFB sensitization was strongly associated with WRS, suggesting that symptoms may be caused by LFB exposure.

A selection bias may be present in this study and prevalence of WRS and sensitization to LFB could be underestimated, because of the so-called healthy worker effect, in which sick or unhealthy workers tend to leave the workplace. In fact the 18.4% prevalence of atopy was slightly lower than the 22% found in the general population of this part of Central Italy [9]. So, atopic subjects and workers sensitized to LFB may have developed WRS and left their jobs.

No associated factors for WRS or sensitization could be identified in the 76 workers exposed to LFB. This seems surprising because atopy and/or degree of exposure were shown to be risk factors of WRS in subjects exposed to high molecular weight sensitizers, like LFB. However this result concurs with those found in laboratory workers exposed to locusts [10] and grasshoppers [11]. Moreover, the relatively low frequency of atopy may explain, at least in part, the absence of association between atopy and WRS or sensitization to LFB.

The degree of exposure was not found to be an associated factor for occupational allergy to LFB. Conclusions between

Table 1. Characteristics and immunologic data of symptomatic subjects

Subject No.	Sex/Age (years)	Smoker	Occupation	Intensity of exposure to LFB*	Duration of exposure to LFB (years)	Type of LFB exposure	Angler	SPT to common allergens	History of asthma/RC	LFB-induced symptoms	SPT to LFB extracts	Serum IgE to LFB extracts
1	M/52	Ex	Laboratory worker	Moderate	10	Mealworm	No	Neg.	No	Mealworm → RC	Neg.	Neg.
2	M/34	Ex	Retailer	Moderate	15	Bluebottle Mealworm Bee moth Gusano rojo	No	Cat (++)	No	Bluebottle → Asthma, RC	Bluebottle (+++) Mealworm (++) Bee moth (++)	Bluebottle > 100 kUA/L
3	M/48	Ex	Laboratory worker	High	28	Bee moth Mealworm	No	Neg.	No	Bee moth → RC	Neg.	Neg.
4	M/44	No	Breeder	High	10	Bluebottle Bee moth	No	Neg.	Asthma	Bluebottle → Asthma	Bluebottle (+++)	Bluebottle 2.75 kUA/L
5	M/57	Yes	Laboratory worker	Low	23	Bee moth	No	DP (++), Dog (++)	Asthma, RC	Bee moth → Urticaria	Bluebottle (++) Bee moth (+++) Gusano rojo (++)	Bee moth 2.14 kUA/L
6	M/38	No	Breeder	High	14	Bee moth	No	DP (++)	No	Bee moth → RC	Bluebottle (++) Bee moth (+++) Gusano rojo (++)	Bee moth 21.7 kUA/L Gusano rojo 4.77 kUA/L
7	M/61	Ex	Breeder	High	20	Mealworm Bluebottle	Yes	Neg.	No	Mealworm → Asthma, RC	Bluebottle (+++) Mealworm (+++) Bee moth (+++) Gusano rojo (++)	Mealworm 23.2 kUA/L Bluebottle 19.6 kUA/L Bee moth 1.46 kUA/L Gusano rojo 0.42 kUA/L

LFB, live fish bait; SPT, skin prick test; RC, rhinoconjunctivitis; DP, *Dermatophagoides pteronyssinus*. *Exposure to LFB was estimated as follows: high: > 5 h/day; moderate: 2–5 h/day; low: < 2 h/day.

Table 2. Immunologic data

	% positive SPT to LFB extracts (n = 76)		% positive serum IgE to LFB extracts (n = 64)	
	Subjects with WRS (n = 7)	Asymptomatic subjects (n = 69)	Subjects with WRS (n = 7)	Asymptomatic subjects (n = 56)
Bluebottle	71.4*	20.3*	42.9	5.4
Bee moth	57.1	13.0	42.9	3.6
Mealworm	28.6	8.7	14.3	1.8
Gusano rojo	42.9	7.2	28.6	5.4
At least one positive	71.4*	27.5*	71.4*	12.5*

SPT, skin prick test; LFB, live fish bait; WRS, work-related symptoms. *Subjects with WRS vs. asymptomatic subjects: $P < 0.05$.

the degree of exposure and sensitization to LFB or WRS should be interpreted with caution as exposure was not measured but estimated by hours per day of exposure to LFB. Moreover, finding no association between intensity of exposure and WRS may be due to the small number of subjects with WRS. On the other hand, duration of exposure seems to influence onset of symptoms in subjects who are occupationally sensitized. This observation suggests duration of exposure could promote onset of WRS in predisposed workers.

In conclusion, sensitization to LFB and WRS are relatively frequent in occupationally exposed workers. LFB sensitization was strongly associated with WRS. No other associated factors of occupational allergy to LFB could be detected. These findings need to be confirmed in longitudinal studies on a larger number of workers.

Acknowledgements

We thank Dr A. Bevan for preparing the LFB extracts, Dr G. A. Boyd for her help in reviewing the manuscript, S. Rometta and M. Francioli for their secretarial assistance. Supported by ISPESL (grant 22/94), Italy.

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