Associations between workplace exposure, work related respiratory symptoms, workplace sensitisation and lung function in insect breeders

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Introduction

There are a number of potential food based breeding and rearing jobs in invertebrates which are associated with allergens such as amplified breeding and rearing facilities. In the UK and possibly other countries, breeding sites may provide workplace exposure to house dust mites and cockroach allergens as well as food allergens such as pollen, moulds and animal dander. Allergens in insects breeders may be associated with the presence of allergens in animal protein, including hen’s egg, milk, fish and crustacean. The aim of this study was to investigate the presence of work related respiratory symptoms and workplace sensitisation in workers who were potentially exposed to a variety of biological contaminants including insect and insect related allergens, dust mites and cockroaches.

Methods

Study Population

12 individuals consented to take part in the study. 20 males and 2 females. Individuals were recruited from all fields of the department in the UK in order to maximise the range and diversity of job role, exposure and potential exposure in the insect breeding. Data was collected from the respondents who worked in the insect breeding facility.

Respiratory Questionnaire

All employees completed a standardised respiratory questionnaire, followed by the HRK (Middle 1988) and ECDIS (Barnes 1994) questionnaires. The questionnaires focused on the occurrence of work related respiratory symptoms and recorded data on the severity of symptoms, including work related respiratory symptoms, wheezing, coughing, use of medication, and work related respiratory symptoms.

Pulmonary function measurement

Vital capacity was measured using a spirometer (Alpha-2, Wissenschaftliches Studiendorf, UK) following NCT guidelines. Measurements of the absolute predicted forced expiratory volume in one second (FEV1), forced vital capacity (FVC), forced inspiratory flow at 75% of vital capacity (FEF75%), forced expiratory flow at 50% of vital capacity (FEF50%) and peak expiratory flow rate (PEFR in three per minute) were recorded.

Extract preparation and specific IgE determination

Frozen samples of locusts, mealworms and brain from the worksite were used to produce protein extracts. Whole insects and brain were separately blended with phosphate buffered saline solution (PBS) 50% v/v and rotated overnight at room temperature. Each solution was then homogenised, filtered and then centrifuged at 4 C at 10000 rpm for 30 minutes. The resulting supernatant was dialysed against PBS and the protein concentration determined (Smith 1988). IgE antibodies were isolated by blood serum and specific IgE antibodies to potential workplace allergens (Blattella germanica, naphthoflavone) were detected using the radioimmunoassay (RIA) method. As a group, median dust and protein levels were significantly higher following factor V area symptoms and peak expiratory flow rate (PEFR in three per minute) were recorded.

Exposure sampling

Personal long term samples were collected in the workers’ breathing zone using IOM sampling heads with either glass fibre filters (TEP, 1.6mm, Millipore) or a collimated flow rate of 2L/min. Samples were collected up to 12 months for each employee. The glass fibre filters were then extracted in a separate laboratory and the filters were extracted in extracts for protein measurement. The worker’s whole body lung function was measured using a spirometer (Master Screen, Germany) before and after sampling was uncorrelated. The personal exposure (mg/m³) and total protein exposure (mg/m³) was calculated as a 1.5 litre time weighted average (8 hour TWA).

Statistical analysis

All analyses were performed by cross tabulation in SPSS (Statistical Package for Social Science) (SPSS Inc, Chicago, USA) on data which were normally distributed and used non-parametric Mann Whitney tests. Logistic regression was used to derive independent odds ratios.

Summary

The study documented a number of clinical and physiological endpoints associated with workplace exposure in the workers investigated.

Main Risks For WRSS

- Symptomatic workers were more likely to be atopic and have reduced FEV25 75 (median FEV25 75 in symptomatic workers was 67% of predicted).
- Sensitised workers were more likely to have reduced FEV25 75 also (median FEV25 75 in sensitised workers was 49% of predicted).
- Difference in proportion of symptomatic and non symptomatic workers showing work related sensitisation was not statistically significant.
- Median dust and protein levels were significantly higher in the factory areas than in the office areas.
- Odds of WRSS (adjusted for smoking, age and length of service) were higher in sensitised (relative to non sensitised) and in factory workers (relative to office workers) but differences were not statistically significant.

Interpretation and Conclusions

This study observed a number of workers perhaps with early signs of occupational respiratory disease, characterised by a 30% reduced FEV25 75 from that predicted, employed in an insect breeding facility. These workers were more likely to be sensitised to workplace allergens than those with lung function within a normal range. They also tended to be atopic.

Given the stage length of exposure to the facility at the time of sampling, it is likely that sensitisation to allergens and the subsequent development of occupational asthma was present.

Although the study is small, it is likely that there is a significant difference in the levels between atopic and non atopic workers exposed to insect allergens. The study also highlights the importance of early removal of individuals with respiratory problems before they are identified.

Future work should assess the impact of removing workers at an earlier stage to prevent further exposure to allergens.