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## Original article

### Allergic disorders in a cookie factory: preliminary results of a cross-sectional prevalence study

**Background:** Although there are numerous studies on occupational allergens, there is little information available regarding the epidemiology of allergic sensitization in the flour industry and particularly in biscuit factories. We have carried out a study of the prevalence of allergic diseases and allergic occupational disorders in such a factory, with identification of the allergens causing sensitisation. **Methods:** A total of 127 workers from a biscuit factory were studied. Clinical and epidemiological information was requested through a questionnaire, and prick tests with common airborne allergens and with allergens related to this type of work were carried out. In addition, patch tests were performed on selected individuals with clinical symptoms suggestive of contact dermatitis. **Results:** The questionnaire was completed by 78 employees (61%). The prick tests were positive in 20 workers (26%) and the patch tests in 5 (6%). Seven workers (9%) with positive prick tests evidenced some form of symptoms in relation to the workplace. There was a statistically significant ( $p<0.05$ ) association between allergic disease and male gender. **Conclusions:** the prevalence of allergic diseases and occupational allergic disorders among workers at a biscuit factory were similar to those found in other studies. These findings should be interpreted with caution, however, as not all the employees in the factory participated in the study.

**Key words:** Prevalence. Occupational asthma. Cookies. Biscuits.

### Patología alérgica en una fábrica de galletas: resultados iniciales de un estudio de prevalencia

**Fundamento:** Se ha realizado un estudio de prevalencia de enfermedades alérgicas y patología ocupacional de naturaleza alérgica en una fábrica de galletas, identificando los alérgenos causantes de sensibilización. **Métodos:** Se estudiaron 127 trabajadores de una fábrica de galletas. Mediante un cuestionario se solicitó información clínica y epidemiológica y se realizaron pruebas cutáneas (*prick test*) con aeroalérgenos comunes y alérgenos relacionados con su medio laboral. Además se realizaron pruebas epicutáneas en individuos seleccionados con sintomatología clínica sugestiva de dermatitis de contacto. **Resultados:** El cuestionario fue cumplimentado por 78 empleados (61%). Las pruebas cutáneas fueron positivas en 20 trabajadores (26%) y las epicutáneas, en cinco individuos (6%). Siete trabajadores (9%) con pruebas cutáneas positivas presentaban algún tipo de síntoma en relación con su lugar de trabajo. Se demostró una asociación estadísticamente significativa ( $p<0,05$ ) entre enfermedad alérgica y sexo masculino. **Conclusiones:** La prevalencia de enfermedades alérgicas y de patología alérgica ocupacional en una fábrica de galletas es similar a la encontrada en otros estudios, aunque al no participar en el mismo todos los trabajadores, los resultados deben interpretarse con cautela.

**Palabras clave:** Prevalencia. Alergia ocupacional. Galletas.

There are a large number of studies regarding occupational allergens causative of allergic sensitization. One of the most important and among the best studied of the occupational diseases is baker's asthma, frequently caused by sensitisation to cereal flour allergens<sup>1</sup> but also to other contaminating allergens such as  $\alpha$ -amylase<sup>2</sup>, storage mites<sup>3</sup> or pulses (*Leguminous vegetables*)<sup>4</sup>.

Epidemiological studies of allergic sensitization in the flour industry (bread bakery, pastry industry) are less frequent<sup>5-8</sup>, and they are scarce in the particular case of cookie and biscuit factories<sup>9,10</sup>. The interpretation of the results achieved is difficult because of the large number of substances to which the workers are exposed and the varying forms and degrees of exposure.

Because of the above, it was decided to carry out a study of the prevalence of occupational allergic sensitization and, at the same time, to take advantage of the study conditions through the administration of a clinical questionnaire and carrying out skin prick and epicutaneous patch tests in order to assess the prevalence of allergic diseases in the sample studied.

## STUDY POPULATION AND METHODS

**Study population.** The study was carried out in a cookie factory employing 127 workers in morning, evening and night shifts.

**Epidemiological data collection.** A non-standardised clinical occupational questionnaire was handed out to all those workers who chose to participate in the study. On the day of the skin tests the questionnaire was reviewed and all existing doubts were discussed with the worker. The questionnaire contained items related to: personal and familial history of allergy; tobacco smoking habit; existence of nasal, ocular, respiratory and skin symptoms; relation of the symptoms to any given area within the factory, place of work: packaging, machines, baking oven/dough kneading, storage, rotation work, small elements (these workers mix foodstuffs and additives in small quantities); chronology of the symptoms (daily, weekends, holidays); duration of employment at the factory; use of protective measures; factory areas in which the worker is presently and/or was previously occupied; previous occupations.

Occupational allergic disease was defined as the presence of symptoms induced by allergens present in the

work environment of the employee in subjects sensitized to those allergens.

**Tests performed.** All the employees who completed the questionnaire underwent allergic assessment through skin prick tests with a panel of commercially acquired common allergens (Bial-Aristegui, Spain) including pollens of grasses, shrubs and trees, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Blatella germanica*, *Blatta orientalis*, cat and dog danders, *Alternaria tenuis*, *Aspergillus* sp., *Cladosporium herbarum*, *Penicillium* sp., *Anisakis simplex*, and with a further panel of allergens related to their occupational environment and comprising *Euroglyphus maynei*, *Acarus siro*, *Tyrophagus putrescentiae*, *Glycophagus domesticus*, *Lepidoglyphus destructor*, *Blomia kulagini*, *Chortoglyphus arcuatus*, latex and the following foodstuffs (C.B.F. Leti, S. A., Spain): wheat, rye, barley, corn (maize), soybean and oat flours, egg white and yolk, ovalbumin, milk and additives ( $\alpha$ -amylase). The  $\alpha$ -amylase is not used at the cookie factory in which the study was carried out, but this improver was included in the allergen panel because of the possible presence in it of workers that might have become sensitized by exposure to that allergen in previous occupations. Other enzymes such as cellulase or subtilisin were not included, as they are not used as dough improvers in our environment.

All those individuals who evidenced or reported symptoms suggestive of contact sensitization, that is, skin lesions compatible with contact eczema, were assessed with epicutaneous patch tests with a standard panel of contact allergens (True-Test, ALK-Abelló, Spain) and with a specific panel of bakery/confectionery contactants (Bial-Aristegui, Spain).

**Statistics.** The association between qualitative variables was tested through the  $\chi^2$  test; when the conditions required were not met, Fisher's exact test for small samples was used. The level of statistical significance was established *a priori* at a p value of less than 0.05.

## RESULTS

Seventy-eight workers out of the 127 employed at the factory (61%) accepted completing the clinico-occupational questionnaire. Most of the workers in the night shift did not participate in the study. The results presented refer to the group of workers who completed the questionnaire and who underwent allergy testing.

Most of the participating workers (74%) were wo-

**Table I.** Clinical and epidemiologic characteristics of the employees who had positive skin tests

| Case No. | Gender | Age (years) | Smoker | Symptoms                    | Time employed<br>at the factory (years) | Skin test results (positive tests)  |
|----------|--------|-------------|--------|-----------------------------|-----------------------------------------|-------------------------------------|
| 17       | Female | 38          | Yes    | Rhinoconjunctivitis         | 16                                      | Pollens (grasses, shrubs)           |
| 19       | Female | 34          | Yes    | No                          | 14                                      | Pollens (grasses)                   |
| 20       | Female | 34          | Yes    | No                          | 12                                      | Grass pollens, dust mites           |
| 21       | Male   | 35          | Yes    | Rhinoconjunctivitis, asthma | 17                                      | Dust mites, rye                     |
| 27       | Female | 34          | No     | No                          | 18                                      | Anisakis                            |
| 28       | Male   | 28          | Yes    | Rhinoconjunctivitis         | 9                                       | Grass pollens, dust mites           |
| 31       | Female | 34          | No     | No                          | 17                                      | Grass pollens                       |
| 34       | Male   | 34          | Yes    | Rhinoconjunctivitis         | 2                                       | Storage mites                       |
| 36       | Male   | 27          | Yes    | No                          | 3                                       | Dust and storage mites              |
| 38       | Male   | 37          | No     | Rhinoconjunctivitis, asthma | 2                                       | Grass pollens, storage mites, wheat |
| 47       | Male   | 29          | Yes    | No                          | 8                                       | Anisakis                            |
| 52       | Female | 37          | No     | No                          | 22                                      | Shrub pollens                       |
| 54       | Female | 39          | Yes    | No                          | 19                                      | Soybean flour                       |
| 56       | Male   | 54          | No     | Rhinoconjunctivitis, asthma | 23                                      | Dust mites                          |
| 58       | Female | 29          | Yes    | Rhinoconjunctivitis         | 1                                       | Grass pollens                       |
| 60       | Male   | 23          | No     | Rhinoconjunctivitis         | 2                                       | Grass pollens                       |
| 71       | Female | 34          | No     | Rhinoconjunctivitis         | 20                                      | Tree pollens                        |
| 72       | Female | 33          | Yes    | Rhinoconjunctivitis, asthma | 19                                      | Grass pollens                       |
| 75       | Female | 28          | Yes    | Rhinoconjunctivitis         | 6                                       | Dust mites                          |
| 76       | Male   | 50          | No     | Rhinitis, urticaria         | 4                                       | Dust mites                          |

men. The mean age was 35 years (SD = 7.3 years) and the mean duration of employment at this factory was 12.3 years (SD = 7.7 years); 51% of the workers were smokers; 23% had a positive family history of allergic complaints, and 24% reported a positive personal history of allergic sensitization.

Twenty workers (26%) had positive results in the skin tests performed; in eight cases (8%) positive skin tests were observed with no known personal history suggestive of previous allergic sensitization or compatible clinical manifestations. Table I summarises the results observed in the workers with positive skin tests.

Among the nineteen employees with a positive personal history of allergic sensitization (24%), twelve evidenced positive skin tests with a compatible clinical history: seven workers (9%) had symptoms of rhinoconjunctivitis—four of them in relation to grass pollens, one to tree pollens and two to mites—; four workers (5%) had rhinoconjunctivitis and asthma—two in relation to grass pollens (one of them was also sensitized to wheat flour) and two to dust mites (one of them was also sensitized to rye flour)—; one worker with rhinitis and chronic urticaria was sensitised to dust mites. One of these twelve workers also evidenced a contact sensitization. A further

four workers had clinical manifestations and epicutaneous test results compatible with contact dermatitis, and one worker was sensitized to penicillin. The two remaining workers had negative skin prick and epicutaneous tests.

As regards the actual place of work, 44 employees (56%) were habitually occupied in the packaging area, 7 (9%) in the machinery section, 4 (5%) were in rotation, 6 (8%) worked in the baking oven/dough kneading area, 3 (4%) in the storage area and 3 (4%) in the "small elements" area. Finally, 11 employees (14%) had other activities and occupations (management, administration, telephone, maintenance, etc.).

Considering the protective measures applied during their working time in the factory, 55 workers (70%) did not use any type or form of protection, 20 (26%) used gloves and 3 (4%) used both gloves and nose plugs.

A correlation existed between the reported symptomatology, the allergic sensitisation(s) and the work performed in seven cases (9%) (Table II). Although three workers were sensitized to house dust mites, a ubiquitous allergen, all three clearly related their symptoms to the exposure to dusty environments in their occupational settings.

As for the epicutaneous patch tests carried out on

**Table II.** Relationship between the symptoms at the worksite and the patient's allergic sensitization

| Case | Worksite           | Allergic sensitization (skin tests) |
|------|--------------------|-------------------------------------|
| 31   | Kneader (rotating) | Rye flour, dust mites               |
| 28   | Packer             | Dust mites                          |
| 34   | Machinist          | Storage mites                       |
| 36   | Stores             | Dust and storage mites              |
| 38   | Kneader            | Wheat flour, grass pollens          |
| 56   | Kneader            | Dust mites                          |
| 76   | Maintenance        | Dust mites                          |

eight workers with possible contact sensitisation, positive results were observed in five cases (6%): four subjects were sensitized to nickel sulfate (one of them also to cobalt), and one was sensitized to caine mix. It should be stressed that in none of these cases did the observed positivities bear any relation to the substances specifically manipulated in their occupational activity. The patch tests performed with the panel of specific contactants were negative in all cases.

A statistically significant ( $p < 0.05$ ) correlation was detected between presence of allergic disease and male gender. However, no correlation was found to the presence of a positive familial or personal history of allergy, nor with tobacco smoking (Table III).

## DISCUSSION

The preferred method for the monitorisation of population groups at risk of sensitization to occupational allergens is that of skin prick testing<sup>11</sup>; this is a simple and cheap method, and for this reason it was selected as the diagnostic test procedure in the present study.

In the Alergológica study on epidemiologic, clinical and socio-economic factors in allergic disease in Spain<sup>12</sup>, a positive family history of allergic complaints was recorded in 6.5 to 23% of the cases, and a positive personal history in 7.8 to 20.6%; in the present study a positive family history was recorded in 23% and a positive personal one in 24% of the cases.

The prevalence of allergic rhinoconjunctivitis among the workers in this cookie and biscuit factory was 9%, similar to the levels reported in other studies that establish the prevalence of rhinitis and rhinoconjunctivitis at between 5 and 20% among the general population<sup>13,14</sup>. As re-

**Table III.** Association between age and gender, personal and family history and tobacco smoking

|                                          | Disease present |    |
|------------------------------------------|-----------------|----|
|                                          | Yes             | No |
| Gender <sup>a</sup>                      |                 |    |
| Male                                     | 9               | 11 |
| Female                                   | 11              | 47 |
| Personal history of allergy <sup>b</sup> |                 |    |
| Yes                                      | 7               | 12 |
| No                                       | 13              | 46 |
| Family history of allergy <sup>b</sup>   |                 |    |
| Yes                                      | 7               | 11 |
| No                                       | 13              | 47 |
| Tobacco smoking <sup>b</sup>             |                 |    |
| Yes                                      | 12              | 28 |
| No                                       | 8               | 30 |

Association to the presence of disease: <sup>a</sup> $p < 0.05$ . <sup>b</sup> $p > 0.05$

gards the prevalence of bronchial asthma, which ranges between 3 and 10% among the various authors and countries<sup>15</sup>, this was 5% in the present study. These data on the prevalence of rhinitis and asthma among workers sensitized to occupational allergens are lower than those reported in another study performed at a cookie factory<sup>10</sup>, in which 14% of the workers had rhinitis and 12.4% had asthma related to their occupational environment. In two studies of the prevalence of allergic diseases in bakers' and confectioners' shops<sup>6,8</sup>, the prevalence of rhinitis was also higher (17.7%<sup>6</sup> and 14.4%<sup>8</sup>) than the one recorded in our present study. However, in the same two studies the prevalence of asthma was similar to our own data, with prevalence levels of 4.9%<sup>6</sup> and 6.4%<sup>8</sup>.

The prevalence of contact dermatitis ranges in various studies between 1%<sup>16</sup> and 10%<sup>17</sup> among the general population; in Spain this complaint has a 7.5% prevalence<sup>18</sup>, similar to the 6% one in the present study.

Considering the previously stated definition of occupational allergic disease, the prevalence of occupational

allergy in this cookie factory would be 9%. However, most of the studies of occupational allergy in bakeries, confectioneries and cookie factories have been fundamentally based on studies of the prevalence of sensitization to cereal flours in bakeries. Those studies place this prevalence at a level between 7.5%<sup>19</sup> and 24%<sup>20</sup>, and among the allergens in cereal flours the pride of place corresponds to wheat flour, which in the study on bakers and confectioners by Armentia *et al.*<sup>21</sup> reaches a level of 25.17%. In another study carried out in a cookie factory by Juste *et al.*<sup>9</sup>, the incidence of occupational asthma due to wheat flour sensitization was 4.9%.

In the present study we found a statistically significant correlation between allergic disease and the male gender, but not between allergic disease and personal or family history or between allergic disease and tobacco smoking; this is in keeping with the results reported by Juste *et al.*<sup>9</sup>. The association between allergic disease and the male gender might perhaps be due, as these authors state, to the possibility that women might more easily quit their work upon becoming sensitized; this would have been even easier in the case of our own factory, as many of the females workers had temporary work contracts.

A further aspect to keep in mind is that of the possible participation bias of the workers in the study. Participation in our study was only 61%; this might have been due to reasons such as fear of being fired or of having to change the area of occupation upon the discovery of a given condition, and even more so as many of the workers, as previously pointed out, have only temporary employment. A further reason might be the incompatibility of working shift times, which caused the absence from the study of most of the workers in the fixed night shift. Because of all these considerations the results of the present study must be interpreted with caution, and further more extensive studies are required for their confirmation.

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