

Exposure-response relations for work related respiratory symptoms and sensitisation in a cohort exposed to α -amylase

Additional data

Introduction

In addition to the exposure-response analyses for α -amylase reported in the short report, we also studied the modifying effect of sensitisation to common (atopy) or bakery allergens on exposure-response relations between exposure to fungal α -amylase, flour aeroallergen, and inhalable dust, and the risk of new work related respiratory symptoms.

Methods

The same categories for inhalable dust and flour aeroallergen were applied as in the previous paper.¹ Three approximately equal sized exposure categories were created. The lowest exposure category included bread wrappers, confectioners (without direct contact with flour), and despatch and quality control staff. The second category included bread and roll makers, cleaners, and other confectioners. Those directly handling flour and mixing or baking dough were included into the highest exposure category. The exposure categories are described in table 1.

Analyses stratified for atopy and a positive SPT to fungal α -amylase or flour, were performed.

Results

The analysis stratified for atopy showed a non-consistent pattern concerning chest symptoms although the point estimates were always >1 in the highest exposure category (table 2). For eyes/nose symptoms the PRs were generally higher among atopics compared with non-atopics. The PRs were significantly higher in atopics of

the highest exposure category of inhalable dust and flour aeroallergen, and in non-atopics of the highest inhalable dust exposure category (table 2).

The PRs for chest as well as eyes/nose symptoms were similar when stratified for SPT to α -amylase or to flour (tables 3 and 4). The precision of these estimates was low.

The predictive value of a positive SPT to flour was 19% (4/21) for chest symptoms and 38% (8/21) for eyes/nose symptoms.

Discussion

The evaluation of atopy as a response modifier was hampered by the low power.

However, for exposure to flour allergen or dust and eyes/nose symptoms there were trends for steeper exposure-response relations in atopics compared with non-atopics.

The analysis of sensitisation to α -amylase or flour as a modifier of symptoms had a low precision but there were no obvious trends. This was a difference compared with a similar study on laboratory animal workers.² In that study the strongest and clearest exposure-response relations were observed among laboratory animal sensitised workers, while non-sensitised workers only showed small increased risks without clear exposure-response relations. This indicates the presence of other pathophysiological mechanisms apart from IgE mediated sensitisation in this cohort of bakery workers and this definition of symptoms.

We also compared our results with the results reported by Cullinan *et al*¹ of the same cohort but obtained with another statistical method of analysis. They used conditional logistic regression in a case-control design. As an example, Cullinan *et al*¹ reported odds ratios (OR) for chest symptoms and medium exposure to flour allergen of 2.1 (95% CI 0.6 to 8.2), and for high exposure 7.7 (1.8 to 33). The corresponding PRs by Cox regression were 0.9 (0.3 to 2.3) and 2.1 (0.9 to 4.8). In general the estimated ORs

were considerably higher than the corresponding PRs. It has been discussed that PRs are better estimates of relative risks than ORs.^{3 4}

Conclusions

Atopics seem to have steeper exposure-response relations for eyes/nose symptoms, compared with non-atopics for exposure to any of the three agents. Odds ratios obtained by case-control design might overestimate the relative risks compared with prevalence ratios.

References

- 1 Cullinan P, Cook A, Nieuwenhuijsen MJ, *et al.* Allergen and dust exposure as determinants of work-related symptoms and sensitization in a cohort of flour-exposed workers; a case-control analysis. *Ann Occup Hyg* 2001;**45**:97–103.
- 2 Nieuwenhuijsen MJ, Putcha V, Gordon S, *et al.* Exposure response relationships among laboratory animal workers exposed to rats. *Occup Environ Med* 2003;**60**:104–8.
- 3 Axelson O. Some recent developments in occupational epidemiology. *Scand J Work Environ Health* 1994;**20**(special issue):9–18.
- 4 Thompson ML, JE Myers, Kriebel D. Prevalence odds ratio or prevalence ratio in the analysis of cross sectional data: what is to be done? *Occup Environ Med* 1998;**55**:272–7.

Table 1 Exposure categories for flour aeroallergen and inhalable dust

Exposure category	Low	Medium	High
Flour aeroallergen level ($\mu\text{g}/\text{m}^3$)			
Arithmetic means (SD)	68 (13.1)	140 (29.5)	237 (22.5)
Number of measurements	88	105	99
Inhalable dust level (mg/m^3)			
Arithmetic means (SD)	0.6 (0.09)	1.1 (1.0)	3.8 (2.5)
Number of measurements	89	103	100

Table 2 Prevalence ratios (PR) for chest and eyes/nose symptoms in relation to exposure categories for fungal α -amylase allergen, flour aeroallergen, and inhalable dust according to atopy

	α -amylase aeroallergen			Flour aeroallergen			Inhalable dust		
	PR	95% CI	n	PR	95% CI	n	PR	95% CI	n
Chest									
<i>Atopics</i>									
Exposure									
Low	1		22	1		8	1		8
Medium	1.0	0.1 to 8.5	1	1.9	0.4 to 9.4	6	0.5	0.1 to 2.3	3
High	2.7	0.7 to 11	3	2.2	0.4 to 11	7	1.2	0.4 to 4.2	8
<i>Non-atopics</i>									
Exposure									
Low	1		22	1		8	1		8
Medium	2.2	0.7 to 7.2	4	0.4	0.1 to 1.7	3	0.6	0.1 to 2.9	3
High	3.2	0.7 to 15	2	2.2	0.8 to 5.9	12	3.8	1.2 to 12	14
Eyes/nose									
<i>Atopics</i>									
Exposure									
Low	1		57	1		17	1		17
Medium	3.8	1.2 to 12	4	2.7	0.7 to 9.9	8	1.3	0.4 to 4.1	8
High	2.1	0.8 to 5.9	5	6.9	2.0 to 24	21	4.2	1.5 to 11	21
<i>Non-atopics</i>									
Exposure									
Low	1		57	1		17	1		17
Medium	1.5	0.6 to 3.7	6	0.9	0.4 to 1.8	14	1.0	0.4 to 2.2	13
High	1.3	0.3 to 5.6	2	1.7	0.9 to 3.3	26	2.5	1.3 to 5.0	27

“n” denotes number of incident cases in each exposure category.

The reference category of low exposure includes those reporting a new chest or eyes/nose symptom, respectively, regardless of a positive or negative SPT to α -amylase.

Table 3 Prevalence ratios (PR) for chest and eyes/nose symptoms in relation to exposure categories for fungal α -amylase allergen and inhalable dust according to SPT to α -amylase

	α -amylase aeroallergen			Inhalable dust		
	PR	95% CI	n	PR	95% CI	n
Chest						
<i>α-amylase SPT</i>						
+ve						
Exposure						
Low	1		22	1		8
Medium	5.6	0.7 to 44	1	0.7	0.1 to 6.8	1
High	3.1	0.7 to 14	2	3.6	1.2 to 11	6
-ve						
Exposure						
Low	1		22	1		8
Medium	1.7	0.8 to 3.7	4	0.5	0.2 to 1.7	5
High	2.3	0.9 to 6.0	3	2.0	0.8 to 4.6	16
Eyes/nose						
<i>α-amylase SPT</i>						
+ve						
Exposure						
Low	1		57	1		17
Medium	7.8	1.8 to 34	2	1.1	0.2 to 5.5	2
High	1.4	0.3 to 5.9	2	3.6	1.4 to 9.0	8
-ve						
Exposure						
Low	1		57	1		17
Medium	1.5	0.7 to 3.3	8	1.0	0.5 to 2.0	19
High	2.3	0.9 to 5.8	5	2.8	1.6 to 5.0	40

“n” denotes number of incident cases in each exposure category.

The reference category of low exposure includes those reporting a new chest or eyes/nose symptom, respectively, regardless of a positive or negative SPT to α -amylase.

Table 4 Prevalence ratios (PR) for chest and eyes/nose symptoms in relation to exposure categories for inhalable dust and flour aeroallergen according to SPT to flour

	Flour aeroallergen			Inhalable dust		
	PR	95% CI	n	PR	95% CI	n
Chest						
<i>Flour SPT</i>						
<i>+ve</i>						
Exposure						
Low	1		8	1		8
Medium			0			0
High	1.7	0.4 to 7.6	3	1.6	0.4 to 7.2	3
<i>-ve</i>						
Exposure						
Low	1		8	1		8
Medium	0.6	0.2 to 1.7	6	0.6	0.2 to 1.7	6
High	2.3	1.0 to 5.3	19	2.4	1.0 to 5.5	19
Eyes/nose						
<i>Flour SPT</i>						
<i>+ve</i>						
Exposure						
Low	1		16	1		17
Medium	0.6	0.1 to 5.2	1			0
High	3.0	1.0 to 9.5	6	2.4	0.8 to 7.2	6
<i>-ve</i>						
Exposure						
Low	1		16	1		17
Medium	1.2	0.6 to 2.2	21	1.1	0.6 to 2.1	21
High	3.1	1.7 to 5.5	42	2.9	1.6 to 5.1	42

“n” denotes number of incident cases in each exposure category.

The reference category of low exposure includes those reporting a new chest or eyes/nose symptom, respectively, regardless of a positive or negative SPT to flour.