

ORIGINAL ARTICLE

Eugenija Zuskin · Bozica Kanceljak
Jadranka Mustajbegovic · E. Neil Schachter
Luka Stilinovic

Respiratory symptoms and immunological status in poultry food processing workers

Received: 11 April 1994 / Accepted: 8 July 1994

Abstract A group of 57 female workers employed in the processing of poultry food and 51 nonexposed control workers were studied to determine the possible relation between respiratory and immunological findings in poultry food workers. The prevalences of all chronic respiratory symptoms were significantly higher in exposed than in control workers ($P < 0.01$) except for occupational asthma. The highest prevalence of chronic respiratory symptoms in exposed workers was found for chronic cough (49.1%), followed by dyspnea (43.9%), rhinitis (38.6%), chronic phlegm (31.6%), and chronic bronchitis (26.3%). Occupational asthma was found in 5.3% of exposed workers. Exposed workers with a positive skin prick test to poultry food extract demonstrated higher prevalences of all chronic respiratory symptoms than those with negative skin tests, although the difference was statistically significant only for rhinitis ($P < 0.05$). The most frequent skin reactions were found for poultry food extract (exposed: 66.7%; control: 25.5%; $P < 0.05$). An increased IgE serum level was found in 19 (33.3%) of the exposed and in four (7.8%) of the control workers ($P < 0.01$). Three exposed workers with occupational asthma demonstrated an increased serum IgE level. Our data confirm previous results indicating that occupational exposure to poultry food dust may be associated with the development of chronic respiratory symptoms and immunological changes in exposed workers.

Key words Poultry food workers · Occupational exposure · Respiratory symptoms · Immunological reactions

Introduction

Respiratory symptoms associated with occupational exposure to different food components have been reported by only a few authors (Brooks 1985; Zuskin et al. 1989, 1992). It is widely recognized that respiratory symptoms are increased following nonoccupational exposure to a wide variety of foods (Uragoda 1966, 1984; Suhonen et al. 1979; Falleroni et al. 1981; Nava et al. 1983; Toorenenbergen and Dieges 1985; Enberg et al. 1988; Birnbaum et al. 1989). Gohte et al. (1983) reported work-related symptoms and positive skin or RAST tests to buckwheat in 28% of workers employed in preparing and distributing plant products. Cases of allergic respiratory diseases including asthma, allergic rhinitis, and allergic bronchitis were found to be induced by contact with pet-fish food (Knusel and Wutrich 1983). Raszeja-Kotelba et al. (1976) described occupational allergy in workers employed in a fish flour factory. Vyskocil et al. (1972) found a high prevalence of chronic bronchitis in workers employed in feed-mixing plants.

The current study represents an extension of our previous epidemiological study of respiratory function in workers employed in the animal food processing industry. In the present study we investigated the prevalence of respiratory symptoms and immunological status in workers occupationally exposed to poultry food dust.

Materials and methods

Subjects

A group of 57 female workers employed in a mill processing poultry food was studied. Workers were exposed to food aerosols during the grinding, weighing, mixing, and packing of different food components. Poultry feed contains soy, sunflower seeds, fish flour, corn, different wheats, four-leaf clover, carotene, vitamins, salt, and minerals.

The mean age of the studied workers was 36 years (range: 20–57 years), the mean height, 164 cm (range: 158–179 cm), and the mean duration of employment in this industry, 10 years (range: 1–30 years). Fifteen percent of the studied workers were smokers

E. Zuskin (✉) · J. Mustajbegovic
Andrija Stampar School of Public Health, Rockefellerova 4,
41000 Zagreb, Croatia

B. Kanceljak · L. Stilinovic
Institute for Medical Research and Occupational Medicine,
Zagreb, Croatia

E. Neil Schachter
Mount Sinai School of Medicine, New York, USA

smoking on the average 12 ± 3.0 cigarettes daily. The poultry food workers were employed in one large working area and thus all had similar exposures to poultry food dust. In addition a group of 51 female nonexposed workers of similar age, duration of employment, and smoking habit was studied as a control.

Chronic respiratory symptoms

Respiratory symptoms were recorded using a modification of the Medical Research Council Committee questionnaire on respiratory symptoms (1960) with additional questions on occupational asthma (World Health Organization 1986). Specific symptoms were determined as follows:

1. Chronic cough or phlegm: cough and/or phlegm production for at least 3 months per year
2. Chronic bronchitis: cough and phlegm for a minimum of 3 months a year and for not less than two successive years
3. Dyspnea grades: grade 3 – shortness of breath when walking with other people at an ordinary pace on level ground; grade 4 – shortness of breath when walking at their own pace on level ground
4. Occupational asthma: recurring attacks of dyspnea, chest tightness, wheezing and pulmonary function impairment of the obstructive type diagnosed by physical examination and spirometric measurements during exposure to dust at or following work

Immunological study

Skin prick tests were performed in exposed and in control workers with aqueous extracts of poultry food, poultry meat, feathers, fish flour, soy, four-leaf clover, molds, and *Dermatophagoides pteronyssinus*. Extracts (1:20 w/v) were prepared using standard immunological techniques employing the material collected in the workroom where workers were examined (Sheldon et al. 1967). In addition workers were skin tested with histamine base (1 mg/ml) and buffer as a control solution. Skin reactions were read after 20 min. A test was considered positive if the diameter of the observed wheal was 3 mm or greater.

The serum level of total immunoglobulin E (IgE) was determined by the Paper radioimmunosorbent test (PRIST) (Pharmacia Diagnostics AB, Upsala, Sweden) using the direct radioimmuno-logic "sandwich" technique based on paper disc as a solid phase (Wide and Porath 1968). A measured IgE below 125 kU/ml was considered normal (Johansson 1968).

Environmental dust measurements

Airborne dust levels were sampled during an 8-h work shift in the work places of the examined workers. Hexhlet two-stage stationary samplers, consisting of a membrane filter preceded by a horizontal elutriator, were used to collect total and respirable dust fractions in the work areas.

Statistical analysis

The χ^2 test and, when appropriate, Fisher's exact test were used to test differences in the prevalence of respiratory symptoms and immunological results. The value of $P < .005$ was considered as significant.

Results

Respiratory symptoms

Table 1 lists the prevalence of chronic respiratory symptoms in exposed and control workers. Significantly higher prevalences of all chronic respiratory symptoms were found in exposed compared to control workers ($P < 0.01$), with the exception of occupational asthma. In exposed workers the highest prevalences were found for chronic cough (28, 49.1%), followed by dyspnea (25, 43.9%), rhinitis (22, 38.6%), chronic phlegm (18, 31.6%), and chronic bronchitis (15, 26.3%). Occupational asthma was recorded in 3/57 (5.3%) exposed workers; their duration of employment was 4, 5, and 6 years respectively and all mentioned that symptoms started 2–3 years after beginning work in this industry.

Table 2 presents the prevalence of chronic respiratory symptoms in exposed and control workers by skin prick test to poultry food extract. The prevalence of all chronic respiratory symptoms was higher in exposed workers with positive skin tests than in workers with negative skin tests. The differences were statistically significant only for rhinitis ($P < 0.05$). In control workers there was no difference in the prevalence of chronic respiratory symptoms between workers with positive and workers with negative skin tests to poultry food extract.

Immunological study

The data on skin prick testing in 57 exposed and 51 control workers are presented in Table 3. All exposed workers reacted to at least one occupational extract. The most frequent reactions to occupational extracts were found for poultry food (exposed: 66.7%; control: 25.5%; $P < 0.01$), followed by poultry meat (exposed: 36.8%; control: 13.7%; $P < 0.01$), fish flour (exposed: 36.8%; control:

Table 1 Prevalence of chronic respiratory symptoms in exposed and in control workers [NS difference not statistically significant ($P > 0.05$)]

Group	Mean age (years)	Mean employment (years)	Chronic cough	Chronic phlegm	Chronic bronchitis	Occupational asthma	Dyspnea grades 3 and 4	Rhinitis	Sinusitis
Exposed (n = 57)	36	10	28 49.1%	18 31.6%	15 26.3%	3 5.3%	25 43.9%	22 38.6%	9 15.8%
			<0.01	<0.01	<0.01	NS	<0.01	<0.01	<0.01
Control (n = 51)	34	9	2 3.9%	2 3.9%	2 3.9%	0 0%	2 3.9%	1 1.9%	0 0%

Table 2 Prevalence of chronic respiratory symptoms in exposed and in control workers with positive and negative skin tests to poultry food extract [NS difference not statistically significant ($P > 0.05$); + positive skin test; – negative skin test]

Group	Skin test	No.	Mean age (years)	Mean employment (years)	Chronic cough	Chronic phlegm	Chronic bronchitis	Occupational asthma	Dyspnea grades 3 and 4	Rhinitis	Sinusitis
Exposed ($n = 57$)	+	38	36	10	20 52.6% NS	13 34.2% NS	12 31.6% NS	3 7.9% NS	19 50.0% NS	18 47.4% <0.05	8 21.1% NS
	–	19	35	9	8 42.1%	5 26.3%	3 15.8%	0 0%	6 31.6%	4 21.0%	1 5.3%
Control ($n = 51$)	+	13	35	9	1 7.8% NS	1 7.8% NS	1 7.8% NS	0 0% NS	2 15.4% NS	1 7.8% NS	0 0% NS
	–	38	34	9	1 2.6%	1 2.6%	1 2.6%	0 0%	0 0%	0 0%	0 0%

Table 3 Prevalence of positive skin prick tests and IgE in exposed and in control workers [NS difference not statistically significant ($P > 0.05$); *Dermat Pteron.*, *Dermatophagoides pteronyssinus*]

Group	Molds	<i>Dermat. pteron.</i>	Feathers	Poultry food	Poultry meat	Four-leaf clover	Soy	Fish flour	IgE
Exposed ($n = 57$)	16 28.1%	13 22.8%	9 15.8%	38 66.7%	21 36.8%	11 19.3%	20 35.1%	21 36.8%	19 33.3%
	<0.01	NS	NS	<0.01	<0.01	NS	<0.01	<0.01	<0.01
Control ($n = 51$)	3 5.9%	18 35.3%	5 9.8%	13 25.5%	7 13.7%	4 7.8%	5 9.8%	6 11.8%	4 7.8%

11.8%; $P < 0.01$), soy (exposed: 35.1%; control: 9.8%; $P < 0.01$), four-leaf clover (exposed: 19.3%; control: 7.8%; NS), and feathers (exposed: 15.8%; control: 9.8%; NS). There was also a significant difference in the prevalence of positive skin tests between exposed and control workers for molds (exposed: 28.1%; control: 5.9%; $P < 0.01$).

Increased serum IgE levels were found in 19 of 57 exposed workers (33.3%) and in 4 of 51 control workers (7.8%) ($P < 0.01$). Eighteen out of 19 (94.7%) exposed workers with increased serum IgE levels and five out of six (83.3%) control workers with increased serum IgE levels had positive skin prick tests to poultry food.

Three exposed workers with occupational asthma (3/57; 5.3%) had positive skin prick tests to poultry food and to other occupational extracts as well as increased total serum IgE level (400 kU/ml, 750 kU/ml, 1105 kU/ml).

Environmental dust measurements

Total dust concentrations ranged from 1.05 to 11.72 mg/m³, with the respirable fraction ranging from 0.53 to 3.63 mg/m³. The highest concentration of total dust was larger than that allowed by the Croatian standards (3 mg/m³). Respirable dust concentrations were also higher than those allowed by the Croatian standards (1 mg/m³).

Discussion

The present study confirms our previous results in animal food workers which suggest effects of the work environment on the development of chronic respiratory symptoms and immunologic findings. A significantly higher prevalence of most chronic respiratory symptoms was found in the exposed workers compared with the control group. Because of the small number of smokers in this group we did not analyze the data by smoking habit. However, a previous study (Zuskin et al. 1989) has shown that smoking, in addition to work exposure, plays an important role in the development of respiratory symptoms.

The majority of our exposed workers (66.7%) reacted to poultry food extract with positive skin tests. In a previous study of animal food processing workers we found similar prevalences of chronic respiratory symptoms and positive skin tests to animal food extracts (Zuskin et al. 1989, 1992). Similarly, in a study of immunological findings in spice factory workers, we found positive skin tests with mixed spice dust allergen in a high percentage of exposed workers (73.3%) as compared with 33.3% of control workers (Zuskin et al. 1988). Increased total IgE serum levels were found in 36.8% of exposed and 9.7% of control workers. No consistent correlation between skin

reactivity and chronic respiratory symptoms was found in that study. In summary, the aforementioned studies suggest high prevalences of abnormal respiratory findings and skin sensitivity to organic antigens in food processing industries, but little correlation between the two.

The prevalence of occupational asthma in the present study (5.3%) is similar to that reported in our previous study in animal food processing workers (5.7%) (Zuskin et al. 1992). A high prevalence of occupational asthma (15.6%), rhinoconjunctivitis (76.1%), and urticaria (34.8%) was described in snow crab processing workers by Cartier et al. (1984). Droszcz et al. (1981) found that 23% of the workers studied in a fish mill factory had possible fish allergy; however, only two of them had elevated serum IgE levels. In their study, chronic bronchitis was diagnosed in 54.7% of the studied workers.

Reactions of the respiratory system to poultry food may be caused by different mechanisms: reaginic and nonreaginic (Cockcroft 1987; Novembre et al. 1988). A previous study by us with isolated guinea pig trachea using animal food dust extracts (Zuskin et al. 1992) suggested that clinical respiratory findings obtained in humans can be simulated in guinea pig tracheal smooth muscle in vitro. These results suggest that such extracts can induce airway constriction by a direct action on airway smooth muscle. The response may represent a nonspecific inflammatory effect or possibly some pharmacologically related phenomenon.

Careful industrial hygiene measures, together with use of effective respirators, should be considered to control health effects from exposure to these types of dusts. In addition, preemployment medical examination (including lung function testing and skin testing) and medical surveillance may help to screen sensitive workers in such an industry. In the case of progressive impairment of lung function or the development of respiratory symptoms, workers should be moved out of high-risk areas.

Acknowledgements This research was supported in part by grant No. JBP 733 from the National Institute of Health, Bethesda, Md., USA and by grant No. R01-01A1 from the National Institute for Occupational Safety and Health, Centers for Disease Control, Atlanta, Ga., USA.

References

- Birnbaum J, Tafforeau M, Vervloet D, Charpin J, Charpin D (1989) Allergy to sunflower honey associated with allergy to celery. *Clin Exp Allergy* 19:229–230
- Brooks SM (1985) Occupational asthma. In: Weiss EB, Segal MS, Stein M (eds) *Bronchial asthma*, 2nd edn. Little Brown and Co., Boston, pp 461–493
- Cartier A, Malo JL, Forest F, Lafrance M, Pineau L, St-Aubin JJ, DuBois JY (1984) Occupational asthma in snow crab-processing workers. *J Allergy Clin Immunol* 74:261–269
- Cockcroft DW (1987) Bronchial inhalation tests. II. Measurement of allergic (and occupational) bronchial responsiveness. *Ann Allergy* 59:89–98
- Droszcz W, Kowalski J, Piotrowska B, Pawlowicz A, Pietruszewska E (1981) Allergy to fish meat factory workers. *Int Arch Occup Environ Health* 49:13–19
- Enberg R, McCullough J, Ownby DR (1988) Antibody responses in watermelon sensitivity. *J Allergy Clin Immunol* 82:795–800
- Falleroni A, Zeiss CR, Lewitz BS (1981) Occupational asthma secondary to inhalation of garlic dust. *J Allergy Clin Immunol* 68:156–160
- Gohte CJ, Wieslander G, Ancker K, Forsbeck M (1983) Buckwheat allergy: health food, inhalation risk. *Allergy* 38:155–159
- Johansson SGO (1968) Serum IgND levels in healthy children and adults. *Int Arch Allergy* 34:1–8
- Knusel EL, Wutrich B (1983) "Aquarium allergy": fish food, another domestic allergen. *Schweiz Med Wochenschr* 113:658–662
- Medical Research Council Committee on the Aetiology of Chronic Bronchitis (1960) Standardised questionnaire on respiratory symptoms. *Br Med J* 1:1665
- Nava C, Brambilla G, Briatico-Vangosa M, Marchisio M, Talamo F (1983) Occupational asthma in food workers: study of three cases. *Med Lav* 74:302–307
- Novembre E, deMartino M, Vierucci A (1988) Foods and respiratory allergy. *J Allergy Clin Immunol* 81:1059–1065
- Raszeja-Kotelba B, Buschke M, Jablonska H, Skuza M, Slomko M, Wanic M, Hryniewicz I (1976) Skin lesions in workers employed in the manufacture of fish flour. *Przegl Derm* 63:435–439
- Sheldon JM, Lowel RG, Mathews KP (1967) *A manual of clinical allergy*. Saunders, Philadelphia, pp 507–531
- Suhonen R, Keskinen H, Bjorksten F, Vaheri E, Zitting A (1979) Allergy to coriander: a case report. *Allergy* 34:327–330
- Toorenenbergen AW, Dieges PH (1985) Immunoglobulin E antibodies against coriander and other species. *J Allergy Clin Immunol* 76:477–481
- Uragoda C (1966) Symptoms among chilli grinders. *Br J Ind Med* 24:162–164
- Uragoda C (1984) Asthma and other symptoms in cinnamon workers. *Br J Ind Med* 41:224–227
- Vyskocil J, Chroma M, Berk I, Lejhanoova G, Pospisil I (1972) The health risks in feed-mixing plants. *Int Arch Arbeitsmed* 29:291–311
- Wide L, Porath J (1966) Radioimmunoassay of proteins with the use of Sephadex-coupled antibodies. *Biochim Biophys Acta* 130:257–260
- World Health Organization (1986) Detection of occupational disease. Geneva, pp 311–318
- Zuskin E, Kanceljak B, Skuric Z, Pokrajac D, Schachter EN, Witek TJ, Maayani S (1988) Immunological and respiratory findings in spice-factory workers. *Environ Res* 47:95–108
- Zuskin E, Mataija M, Pokrajac D, Schachter EN, Witek TJ (1989) Respiratory function in animal food processing workers. *Am J Ind Med* 16:179–187
- Zuskin E, Kanceljak B, Schachter EN, Witek TJ, Maayani S, Goswami S, Marom Z, Rienzi N (1992) Immunological and respiratory changes in animal food processing workers. *Am J Ind med* 21:177–191