

## Bronchial asthma in children and teenagers and their exposition to house dust mites in urban area in the Upper Silesia. A preliminary study

Astma oskrzelowa u dzieci i młodzieży a ekspozycja  
na roztocze kurzu domowego w środowisku miejskim  
na Górnym Śląsku. Badanie wstępne

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### ABSTRACT

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Dust mite allergens are common factors causing bronchial hypersensitivity in children with diagnosed bronchial asthma. As one of the main type of allergens in the domestic environment, they take a significant part in this process. The authors studied the severity of bronchial asthma (according to GINA 2006) of 16 children and teenagers with confirmed allergy to mites, who lived in the city situated in Upper Silesia, in correlation to acarofauna of their dwellings. Mite species, their number in 1 g of dust and guanine concentration in 1 g of dust (Acarex test) were examined in 57 house samples from 16 houses or flats. The dominant species were *Dermatophagoides farinae* and *D. pteronyssinus*; other species of mites, such as: *Euroglyphus maynei*, *Gymnoglyphus longior*, *Acarus siro*, *Tyrophagus putrescentiae*, *Lepidoglyphus destructor*, *Lepidoglyphus fustifer* occurred only sporadically. There was no correlation found between the severity of bronchial asthma and the level of exposure to mite allergens from household environments in the studied group of mite-sensitive children and teenagers.

#### KEY WORDS

bronchial asthma, allergy to mite antigens, house dust mites, children, teenagers, Upper Silesia

## STRESZCZENIE

U dzieci z astmą oskrzelową alergeny roztoczy kurzu domowego są często czynnikami powodującymi nadreaktywność oskrzeli. Jako jedne z głównych alergenów w środowisku domowym mają w tym względzie duże znaczenie. Autorzy poddali analizie stopień ciężkości astmy oskrzelowej (wg GINA 2006) u 16 osób w wieku rozwojowym mieszkających w mieście na Górnym Śląsku), wykazujących alergię na roztocze, w odniesieniu do akarofauny kurzu z ich mieszkań. Pod uwagę wzięto gatunki roztoczy, ich liczbę w 1 g kurzu oraz stężenie guaniny w 1 g kurzu (Acarex test). Dominującymi gatunkami były *D. farinae* i *D. pteronyssinus*, a inne gatunki roztoczy (*Euroglyphus mayenei*, *Gymnoglyphus longior*, *Acarus siro*, *Tyrophagus putrescentiae*, *Lepidoglyphus destructor*, *Lepidoglyphus fustifer*) występowały sporadycznie. Nie stwierdzono zależności stopnia ciężkości astmy oskrzelowej od stopnia narażenia na alergeny roztoczy w środowisku domowym osób objętych badaniem.

## SŁOWA KLUCZOWE

astma oskrzelowa, alergia na alergeny roztoczy, roztocza kurzu domowego, dzieci, młodzież, Górny Śląsk

## INTRODUCTION

House dust is a heterogeneous substance, which consists of many components that can induce allergic response. Most of them are connected with allergy to mite antigens. Inhalant antigens often induce hyperresponsiveness, which is the main bronchial asthma symptom. At present, 5 species of mites of Pyroglyphidae family [1,2] were found in house dust samples in Poland. The concentration of 100 mites/g of dust or 0.6 mg guanine/g of dust are possible threshold levels causing allergic reaction in predisposed people [3].

The aim of the study is to find out whether there is a connection between asthma severity of young patients and house dust acarofauna from their dwellings in urban area in Upper Silesia.

## MATERIAL AND METHODS

**Allergological studies.** The total number of 16 children – 14 boys and 2 girls – suffering from atopic bronchial asthma, at the age ranging from 4 to 17 years (mean age – 10.5 years) were included with this study. All children lived in urban environment (Bytom) situated in Upper Silesia. According to GINA 2006 classification, 1 child was diagnosed with se-

vere asthma, 9 with moderate, and 6 with mild asthma. Moreover, 4 children (25%) suffered from atopic eczema and 9 (56.2%) from the perennial allergic rhinitis. Allergy to house dust mites was confirmed according to the current standards [4]. Skin tests results of all patients were positive for mite allergens of house dust – *Dermatophagoides pteronyssinus* (*Der p*) and *Dermatophagoides farinae* (*Der f*), as well as serum tests were positive for specific IgE antibodies to mite antigens (*Der p* and *Der f*). IgE antibody concentration was estimated with ELISA method using Allegopharma reagents. The results were interpreted according to the following criterions:

17.5 IU/ml – very high level,  $\geq 3.5 < 17.5$  IU/ml – high level,  $\geq 0.7 < 3.5$  IU/ml – moderate level,  $\geq 0.5 < 0.7$  IU/ml – low level,  $< 0.35$  IU/ml undetectable level.

The levels of IgE antibodies in 11 children were very high both for *Der p* and *Der f*; in 1 child very high for *Der p* and high for *Der f*; in 1 – high both for *Der p* and *Der f*, 1 – high for *Der p* and moderately high for *Der f*, 1 – moderately high for *Der p* and *Der f*, 1 – moderately high for *Der p* and low for *Der f*.

Apart from positive results of skin tests with mite allergens, the results of grass pollen tests were also positive 2 children, cat's fur and in mould 1 child, mould allergens for 2, and egg white in 1 child.

The highest intensification of bronchial asthma symptoms and possibly allergic rhinitis

appeared in 11 children (68,7%) from September/October to November/December, for 3 children – from October/November to February/March, in 1 child – from May to June and in 1 child from July to September.

**Acarological analysis.** The total number of 57 house dust samples from 16 houses or flats of atopic patients were analysed for the presence of house dust mites. The dust samples were collected from beds, upholstery and wooden furniture, carpets, wooden floors, linoleums and some other places (bedroom walls, pillows, sheets, quilts). A surface of 1m<sup>2</sup> in each sampling site was vacuumed for 2 minutes. Subsequently, each dust sample was weighted in a 150 ml beaker and analysed for mites as it was previously described in details [5]. All mites were mounted in Hoyer’s medium on slides. Species and life stage were determined with the aid of a compound microscope. Mite density was given as a number of specimens per 1 g of dust. Mites which were alive at the time of sampling, could be easily distinguished as intact (not damaged) individuals and because

of their plump and/or white appearance. An indirect method (semiquantitative guanine determination, Acarex® test) was used for evaluation of guanine content (≅ level of mite fecal allergens). According to the manufacturer’s instructions the Acarex test results were expressed in seven increasing classes as follows: – – – (= -3.0), – – (= - 2.0), – (= -1.0), –/+ (= 0.0), + (= 1.0), ++ (= 2.0) and +++ (= 3.0), including also intermediate values. Moreover, the evaluation of guanine content may be performed as follows: for values from -1 to -3 guanine content is < 600 µg/g of dust; for 1.0 guanine content is between 600 and 2,500 µg/g of dust; for 2.0 it is between 2,500–10,000 µg/g of dust, and for 3.0 – it is of at least 10.000 µg/g of dust (according to Pauli *et al.* [6]).

RESULTS

Table I presents the overall obtained results. The weight of samples ranged from 0.01 to 2.4 g. Out of total number of 57 examined dust

Table I. Clinical features of examined patients in comparison with acarofauna of their dwellings

Tabela I. Zestawienie danych klinicznych charakteryzujących badane dzieci w odniesieniu do akarofauny ich mieszkań

Subjects examined	Asthma severity	Specyfic IgE IU/ml		Occurrence of the allergenic mite taxa										Number of domestic mites per gram of dust			Acarex test*
		Der p	Der f	DP	DF	EM	GL	TP	AS	LD	LF	GD	Mean	Maximum	SD		
1.	Moderate	≥ 17,5	≥ 17,5		++								6.3	12.9	6.4	< 0,6	
2.	Moderate	≥ 17,5	≥ 17,5	++	+	++	+						20.7	43.4	21.7	< 0,6	
3.	Moderate	≥ 17,5	≥ 17,5	++	+								461.1	733.4	401.5	< 0,6	
4.	Moderate	≥ 17,5	≥ 17,5	++	+								295.8	933.35	441.0	< 0,6	
5.	Severe	≥ 17,5	≥ 17,5	++	++							+	165.3	466.7	261.4	< 0,6	
6.	Mild	≥ 0,7 < 3,5	≥ 0,5 < 0,7										NF	NF	NF	< 0,6	
7.	Moderate	≥ 17,5	≥ 17,5	+	+++++++				+				693.7	5000.0	1630.2	< 0,6	
8.	Mild	≥ 17,5	≥ 17,5	+++	+								146.7	380.0	202.5	< 0,6	
9.	Moderate	≥ 3,5 < 17,5	≥ 3,5 < 17,5	+++									189.8	475.0	248.9	< 0,6	
10.	Mild	≥ 17,5	≥ 17,5	+++								++	125.5	276.9	132.7	< 0,6	
11.	Mild	≥ 0,7 < 3,5	≥ 0,7 < 3,5	+++								+	18.9	40.0	19.2	< 0,6	
12.	Mild	≥ 3,5 < 17,5	≥ 17,5		++								12.8	24.1	12.1	< 0,6	
13.	Moderate	≥ 17,5	≥ 3,5 < 17,5										NF	NF	NF	0,6–2,5	
14.	Moderate	≥ 17,5	≥ 17,5		++								4.7	7.5	4.1	0,6–2,5	
15.	Mild	≥ 17,5	≥ 17,5		+								1.6	4.8	2.7	0,6–2,5	
16.	Moderate	≥ 17,5	≥ 17,5		+++								52.8	80.0	42.9	0,6–2,5	

NF – not found; DP – *Dermatophagoides pteronyssinus*; DF – *Dermatophagoides farinae*; EM – *Euroglyphus maynei*; GL – *Gymnoglyphus longior*; TP – *Tyrophagus putrescentiae*; AS – *Acanus siro*; LD – *Lepidoglyphus destructor*; LF – *Lepidoglyphus fustifer*; GD – *Glycyphagus domesticus*; SD – Standard Deviation; +, ++, +++, ++++++ – occurrence in 1, 2, 3 or 7 samples examined from the particular flat

\* guanine content in µg/gram of dust (according to Pauli *et al.* [7])

NF – nie znaleziono; DP – *Dermatophagoides pteronyssinus*; DF – *Dermatophagoides farinae*; EM – *Euroglyphus maynei*; GL – *Gymnoglyphus longior*; TP – *Tyrophagus putrescentiae*; AS – *Acanus siro*; LD – *Lepidoglyphus destructor*; LF – *Lepidoglyphus fustifer*; GD – *Glycyphagus domesticus*; SD – Odchylenie standardowe; +, ++, +++, ++++++ – obecność roztoczki w 1,2,3 lub 7 próbkach kurzu z poszczególnych mieszkań

\* stężenie guaniny w µg/g kurzu (wg Pauli i wsp. [7])

samples, 37 (64.9 %) were positive for mites. A total number of 534 mite specimens was isolated, including 494 members of Pyroglyphidae family (92.51%). The dominant species were *D. pteronyssinus* (n=339; 63.5% of all mites) and *D. farinae* (n = 151; 28.3%). Additionally, 3 specimens of *Euroglyphus maynei* (0.6%) and 1 specimen of *Gymnoglyphus longior* (0.2%) were collected. Pyroglyphid mites were found in all positive for mites samples. It should be marked, that 14 out of 16 examined dwellings were positive for allergenic domestic mites (87.5%) (tab. I).

Only 7 dwellings (43.75%) were additionally inhabited by non-pyroglyphid domestic mites, mainly of Glycyphagidae (*Lepidoglyphus destructor*, *L. fustifer*, *Glycyphagus domesticus*), Acaridae (*Tyrophagus putrescentiae*, *Acarus siro*) and Cheyletidae families.

Generally, the total mean number of mites per 1 g of dust varied among mite positive dwellings from 1.6 to 693.7 (tab. 1).

Mean values of Acarex test levels in the examined samples ranged from -3.0 to 1.5. Guanin contents, after recalculation of mean and/or median values of Acarex steps, were approximately included between < 0.6–2,5 mg per gram of dust (tab. I).

No correlations were found between the of the severity of asthma and neither the type of mites found in dust samples in the flats, nor the number of positive samples. Maximal number of mite specimens was lower than 100 per 1g of dust in the flats of 4/6 children with mild asthma (66.6%) and 4/9 children with moderate asthma (56.2%), including dust samples from one flat of each distinguished group negative for mites. The level of asthma severity did not correlate with guanin concentration/1g dust.

The boy, in whose flat the highest number of positive for mites dust samples and the highest number of mites per gram of dust were observed, apart from bronchial asthma suffered also from the perennial allergic rhinitis and atopic eczema. Among 6 other patients, in whose flats dust samples contained a great number of mites ( $\bar{x}$  = 125.5–461.1; max 276.9–933.35), 4 suffered from, apart asthma, the perennial allergic rhinitis including one of them suffering additionally from atopic eczema (this person was not only allergic to mites but also to grass pollen). Consequently, among patients ill with bronchial asthma and highly exposed to house dust mites, 71.4% suffered from the per-

ennial allergic rhinitis. The maximal number of mites in samples from six flats was low (< 35/g dust), what is more their presence was not confirmed in 2 of the flats. Out of 6 children with asthma living in those six flats, 4 (66,6%) suffered from the perennial rhinitis, including 1 boy who was also allergic to cat's fur and mould.

The level of specific IgE antibodies to *Der p* and *Der f* antigens in blood of examined persons did not correlate, neither with the number of dust samples positive for mites of *Dermatophagoides* genus, nor with the number of mites and guanin level in 1 gram of dust.

## DISCUSSION

Mites are the main source of allergens of the house dust, which are mainly components of fecal pellets of these arachnids. Among some predisposed people, these allergens can initiate bronchial asthma, perennial allergic rhinitis or/and atopic eczema. Acarofauna of house dust from flats in Upper Silesia studied at the end of the 20<sup>th</sup> century was diverse. The dominant species were *D. farinae* and *D. pteronyssinus* [1,2,5]. This domination was confirmed by the results of presented studies, performed in Bytom. Other mite species which were identified in single samples of house dust taken in the flats of children with bronchial asthma and diagnosed allergy to mites were: *Euroglyphus maynei* and *Gymnoglyphus longior* (Acaridida: Pyroglyphidae), *Tyrophagus putrescentiae* and *Acarus siro* (Acaridida: Acaridae), *Lepidoglyphus destructor*, *L. fustifer* and *Glycyphagus domesticus* (Acaridida: Glycyphagidae), Cheyletidae (Actinedida) and Gamasida.

In comparison to our results (64.9% of dust samples positive for mites) Racewicz [7], who evaluated house dust in the Tricity, found mites only in 37.3% of samples from the private flats and 95% of them were *D. farinae* (82.8%) and *D. pteronyssinus*.

The periods of the greatest intensification of symptoms connected with mite allergy were defined for the Upper Silesia from May to July and from September to November [5]. They were longer for the patients from presented studies. It lasted till December for most of them and in some individual cases even till February/March, which could be the result of climatic and living conditions changes. We did

not observe any relation between the bronchial asthma severity with or without coexistence of other symptoms of allergic diseases of children with diagnosed allergy to house dust mites and the level of exposure to mite allergens in the households of our small group of patients. Ashad et al [8] and Morgan et al [9], however consider that the decrease of mite concentration in the environment lowers the intensification of asthma symptoms of children.

While analysing the received results, it ought to be considered that the exposure to mite allergens occurs also outside the households. In case of children and teenagers it most often takes place at school. Presumably, this could be the reason of why we did not observe any significant differences in the frequency of occurrence of the perennial allergic rhinitis between children highly exposed to mite allergens at their homes and children whose contact with these allergens was limited. Cieślak and Szmidt [10] proved that mite concentration in house dust was positively correlated with the intensification of allergic rhinitis symptoms, while Terrehorst et al [11] did not find any interrelation like that. Worth mentioning is the fact that the highest number of mites per 1g of dust

in the dust samples from only 6 flats (37.5%) was smaller than 35, which is recommended amount for the patients with diagnosed mite allergy [12]. Presented results could be confirmed for a larger study group, however the requirements for precise dust sampling were difficult to accept for many parents.

## CONCLUSIONS

1. Children with allergy to house dust mites in clinical form of bronchial asthma with/ or without perennial allergic rhinitis and atopic eczema, living in a city (Bytom) in the Upper Silesia, in their household environments are exposed mainly to *D. farinae* and *D. pteronyssinus* allergens. Other mite species (*E. maynei*, *G. longior*, *T. putrescentiae*, *A. siro*, *L. destructor*, *L. fustifer* and *G. domesticus*) occur in the dust in their flats sporadically.
2. There was no correlation found between the severity of bronchial asthma and the level of exposure to mite allergens from household environments in the studied group of mite-sensitive children and teenagers.

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