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Analysis of the environmental risk factors on the asthma control in patients with bronchial asthma

Wpływ środowiskowych czynników ryzyka na kontrolę astmy u chorych na astmę oskrzelową

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Abstract

Analysis of the environmental risk factors on the asthma control in patients with bronchial asthma. Asthma is a very common chronic inflammatory disease of lower airways that affects the everyday life of patients with wheezing and chest tightness. due to reversible airways obstruction. The goal of asthma management is to achieve optimum disease control. The identification of environmental risk factors leads to optimal controlled asthma. From January 2010 to December 2010, 263 (132 men,131 female; age ranged from 18 to 56) subjects with bronchial asthma were observed from Allergy Outpatients. All examined patients were subjected to interview concerning environmental exposure and fulfilling asthma control test ACT^{TM}. It seems that exposure to environmental factors may be favourable to the occurrence of worse control of asthma.

K**eywords**: control asthma, Asthma Control Test ^{TM}, environmental factors, indoor environments

Introduction

Asthma is a very common chronic inflammatory disease of lower airways that affects the everyday life of patients who suffer from it and clinically characterized by attacks of breathlessness (dyspnea) with wheezing and chest tightness due to reversible airways obstruction. The goal of asthma management, according to the GINA guidelines, is to achieve optimum disease control. Several epidemiological surveys have shown that a substantial proportion of patients have suboptimal asthma control [1]. Control of asthma has been defined by guidelines. However, it has a different meaning for patients, physicians, or regulatory authorities. The decision to step up, step down or not change therapy is often determined by the doctor after assessment of the patient at a clinic visit. Improved control of asthma leads to a significant reduction in costs, which are often due to uncontrolled disease and result from admission to hospital, use of emergency services, and absenteeism from school and work. Therefore, controlling the condition benefits patients in particular and society in general. The identification of environmental risk factors for poorly controlled asthma is important from a clinical standpoint in order to better direct intervention strategies designed to enhance patient self-management of asthma. Patients with bronchial asthma are always exposed to varying concentrations of these mold particles everywhere such as home, school, working place or outdoors [3,9]. These environmental factors can interact and lead to deficient control of the disease.

This paper aims to give an influence of the indoor environment risk factors on the asthma control in patients with bronchial asthma in Poland.

Materials and methods

Subjects

From January 2010 to December 2010, 263 subjects with bronchial asthma were recruited and observed from the Allergy Outpatients in Swiecie and Bydgoszcz, Poland. A total of 263 patients participated in this study: 131 women, 132 men. The age ranged from 18 to 56. A total of patients were diagnosed as allergic bronchial asthma, respectively; 156 patients had seasonal symptoms, and 107 patients had perennial symptoms. (interview, medical examination, positive allergy tests partly confirmed by specific IgE antibodies). Patients provided written informed consent. Characteristics of the group is presented in table I. All patients fulfilled a survey concerning environmental exposure mainly to mold.

Selection Criteria

Questionnaire

The questionnaire evaluating the home environment was administered to the study. Questions regarding personal and demographic features (age, gender, educational background, making history) were included in the questionnaire. In the second part of the questionnaire, features of the houses they live in (the age of the house, ownership, on which floor they live, whether the house gets sunlight, whether it gets dampness, type of heating in winters, whether there was a removal of the earlier mold at home and therefore the house has been repaired recently) were questioned. While defining the living conditions, flats built 40 years ago or earlier were arbitrarily regarded to be old. Several variables such as the number of individuals living in the house, the number of smokers, existence of pets, and existence of dampness on the floor or ceiling were also evaluated.

Asthma control test

Every patient was given instructions concerning question analysis and fulfilling asthma control test ACT^{TM,} and the test brochure was given out. Test completion was planned directly before the subsequent visit. The ACT, a patient-completed questionnaire, contains 5 questions, which require responses on a 1 to 5 scale, where higher scores reflecting better asthma control. The ACT assesses the effect of asthma on daily functioning, daytime asthma symptoms (shortness of breath), nocturnal symptoms, use of rescue medications, and self assessment of asthma control. Maximum mark is 25 points and testifies to a very good asthma control. The result between 20 and 24 points is estimated to be satisfactory, however the outcome of less than 20 points is unsatisfactory. Asthma control test is a screening examination of the wrong disease control [8].

Skin Prick Tests (SPT)

SPTs were performed by a trained nurse with a panel of Dermatophagoides pteronyssinus and D. farinae and grass, tree, weed pollens, cat and dog antigens. (Stallergenes, France). Each patient was tested on the same day by the same technician. The volar surface of both forearms was used so that the space between each test solution was at least 3cm. The drop of the extract was wiped off 1 minute after the prick. The skin reaction was recorded after 20 minutes. A mean wheal diameter 3mm or greater than control solution was considered positive. Histamine dihydrochloride (10 mg/1 ml) and glyceroldiluents were used each time as positive and negative control subjects, respectively.

Method of statistical analysis

All the analyses were performed using programmes Statistica version 8.0 and Excel. Comparisons between categorical variables were performed by the chi-square test. P values lower than 0,05 were considered significant. In a few cases the chi-square test with Yates's correction was used. To assess whether there is a difference in the trend of the proportions in the two group the chi-square test for trend was performed.

Results

A total of 263 adult patients participated in this study: 131 women, 132 men. The age ranged from 18 to 56. A total of patients were diagnosed as allergic bronchial asthma, respectively; 156 patients had seasonal symptoms, and 107 patients had perennial symptoms.

The asthma control test was related to sex of the patients. Full control represented suitably 46% male and 53% female, but lack of the control respectively 57, 42 per cent. Female were sex with better control. The greatest group (40%) with control with 20to 25were among patients younger than 35 years. The proportions of people with worse control of asthma increased with age . Among people younger than 25 years it was 18%, in the next age group it was 19%, and in the oldest one the proportion rose up to 35% ($p1<0,001$ for trend). Only 38% of patients having higher than a secondary education had full control, whereas in the group of patients having a secondary and lower education were 20 to 32%. ($p1=0,03$ for trend). Characteristics of the group and their relationships to control asthma /ACT/ is presented in table II.

Asthma Control was significantly associated with place of residence. Over 45% of patients lived in the city above 50 th, while the percent of patients living in the rural environment was only 17%. Analyzing active smoking among patients it should be concluded that 40% patients with full control (25 points) never smoked, whereas in the group without control of asthma respectively less than 20%. The difference in the smoking habits remained statistically significant when the group of smokers was divided into the group of former and current smokers. Passive smoking in the surrounding environment (at home or at work) was given by 61% of patients with full control, 68% of patients with partial control (20-24 points) and 74% without control (Table III). The difference between these proportions is significant.

The analysis of living conditions is presented in Table IV. Concentration of people in flats was statistically greater among patients without control asthma than among patients with full control of bronchial asthma. Among patients sharing flats with less than 3 people there was 56% with full control, in the group sharing flats with more than 3 and less than 5 people there

was 37% with full control, and in last group with more than 5 people only 6% had full control morbid process (p1<001 for trend).

Respectively 7% and 18% of patients with and without control described their flats as damp, almost 15% and 31% as old, and almost 8% and 23% of these patients do not have a central heating. All of these percents were significant. We found association between the possession of animals in the house and control. Molds and damp it should be stated that in homes of patients without asthma control, mold and damp spots on walls are statistically more frequently visible than among patients with full control (Table V). Also the analysis of this feature showed statistically significant difference.

Discussion

Bronchial asthma is a chronic disease of the respiratory system constituting a serious problem to public health all over the world. It concerns people of all ages and may have a severe, and sometimes even fatal course. In November 2006 a new updated report of the Global Initiative for Asthma (GINA), developed by an international group of experts, was published, and it includes guidelines concerning the diagnosis, treatment and prevention of asthma. The new GINA report completely changes the approach to asthma treatment [6]. Asthma therapy according to the new standards is focused on patients and their clinical condition and needs. Its main aim is to achieve and maintain total control of the disease. GINA 2006 introduced an asthma control test to assess the degree of the disease control. Lack of a single easily-measured assessment parameter of asthma control until now has constituted a restraint in the struggle with the disease. It seems that the same function is fulfilled by asthma control test (ACT^{TM}) which includes only five questions. This test developed by Nathan and collaborators [8], is clear, easy for a patient to complete, and its results are easy to interpret. The effective asthma treatment consists in the control of clinical symptoms, both at night and during the day, and in the maintenance of normal life activity of the patient. Control asthma connect with environmental factors particularly indoor exposures, especially at home. The presence of high visible mold and mother's smoking during infancy were the strongest risk factors for a control asthma at the age of 3 years. Among adults, there are a smaller number of studies that have found an increased risk of asthma/ asthma symptoms in damp/moldy buildings. Indoor conditions are important for exacerbation of allergic diseases, such as existing asthma, as well as allergic sensitization [9]. Damp and moldy indoor environments aggravate pre-existing asthma. Recent meta-analyses suggest that exposure to damp and moldy workplaces can induce new-onset adult asthma. IgE mediation is a rare mechanism, whereas other

mechanisms are unknown [7]. Our study concerns adult patients with bronchial asthma. Above quoted papers concerning the description of the indoor environment are also partly confirmed among our patients with mold allergy. The observed relations between mold exposure and wheezing confirm the results of epidemiologic studies among adults in many countries [5].

More and more important role in the therapy is given to the patient. Present-day perception of the patients' role in the treatment of chronic diseases is based on their controlled participation. Owing to this procedure it is possible to decrease the number of hospitalizations and visits in primary care departments, additional unplanned doctor visits, sickness absence at work and nighttime awakenings caused by asthma.

In the present study, full control of asthma presents about 32% of patients with bronchial asthma. Such low percentage of patients with full control can be to result from environmental factors and different factors connected with the treatment too. However, it should also be emphasized that among our patients large percentage above 50% came from the country and small towns, where factors of mold allergy occurrence were confirmed statistically significantly in this group. Also, the fact of obtaining such results may be connected with the choice of the group of only adult patients. It is not known what determines the mechanisms in each individual case, but environmental conditions are likely to play an important role. Indoor environments with dark, damp, and poor ventilation conditions are convenient for fungal growth.

Fungal growth is affected by many factors such as temperature, dampness, indoor heating systems, age of home, keeping pets in homes, or leakages in the plumbing system [10]. In our study many patients had difficulties in determining the age of the building and the degree of dampness in their present home and still more in their previous home. Therefore, some points required additional discussion. The most consistent findings in this study were the increased risks of loss control of asthma among subjects reporting exposure to visible mold growth or ETS in the home environment. Among patients with worse control of asthma poorer living conditions were prevalent. These were older houses often with greater concentration of people and with molds present on walls. Poorer condition of the house, older house age, lack of exposure to sunlight, and lack of insulation were identified as additional environmental factors for worse control. In our study it should be taken into account that occurrence of damp and mold may be greater than it was obtained in the results, as it seems that in Polish conditions this question is still often associated with conscious negligence of home. Attention should be paid to the fact that statistically more frequent was worse control of asthma in older homes, with visible mold spots which often required renovation. In our study, the amount of viable fungus was found to be higher in patients living in older buildings (more than 40 years old)

than in patients living in new buildings independent from the mean heat and humidity values of the environment.

Also presence of a pet at home statistically more often occurred in the homes of patients with worse control. In a study by Ren, [10] heat, relative humidity, season, and the presence of cat in the house were the factors effective on indoor mold growth.

Our patients with worse control of asthma reported a higher indoor dampness compared with patients with good control (18% in patients under 20 points and 9% in patients with 25 points). A high rate of indoor mold spots was detected relatively in compare groups. Although no association between the observed mold spots and the amount of viable fungus related with the level was reported, the detection of mold in all of the houses can reflect the size and importance of the problem. There are various studies indicating that asthma symptoms are negatively affected and leads to loss of the asthma control by the presence of these factors [2,3]. The negative influence of tobacco smoke on the course of bronchial asthma is complex and includes direct toxic effect on the respiratory system epithelium. It is estimated that in developed countries percentage of patients with bronchial asthma who smoke tobacco reaches 17–35% (Dong reported that environmental tobacco smoke, pests and visible mold on walls were associated with the occurrence of exacerbation asthma symptoms [4]. Our study does not allow us to draw such serious conclusions, however statistically there are more patients with worse and bad control who smoke cigarettes than in group with good control. Potential environmental risk factors such as indoor air pollution, infections, allergen exposure, diet, and lifestyle patterns may trigger respiratory symptoms and to worsen lung function. Specific features of urban and rural lifestyle may constitute distinct risk factors but may also coexist within certain socioeconomic levels. Patients of rural environments are at lower risk for asthma and aeroallergen sensitization. However, among our patients the relationship between worse control and living in the country is statistically significant. In our group evidence to date supports a strong relation between residential area as a potential risk factor for exacerbation asthma symptoms and airway obstruction and a western type of socioeconomic development.

Assessment of the health effects of indoor factors exposure is complicated by the diversity of mold species found in homes and the limitations of current methods to determine exposure. The habit of ill people to seek an explanation for symptoms might lead to the association between home dampness and disease. In the present study, subjects with worse control are more frequently exposed to environmental risk factors connected with mold, which is related to a greater risk of developing allergy, exacerbation and consequently with unfavorable

prognosis . These studies suggest that some factors directly or indirectly related to control asthma.

The results of this study demonstrated that the ACT is reliable, valid, and responsive to changes in asthma control over time in a sample of asthmatic outpatients under the care of an asthma specialist. Based on this tool, we found that the ACT correlates significantly with the environmental factors mainly indoor exposure on molds.

We analysed harmful factors of environment, a valid and reproducible tool to assess quality of life in asthma and to estimate of ACT scores with the multidimensional effects of asthma on daily life. In the present study, we correlated ACT scores and environmental factors.

Conclusions

The results of this study support the association between reported respiratory symptoms and environmental factors in the home. It seems that patients with worse control of bronchial asthma are characterized by more difficult living conditions, worse ventilation and greater concentration of people at homes. These patients also tend to live in older housing with less insolation. Environment of patient without harmful factors of indoor exposure are related to better control; therefore, increased awareness could help to improve control. Planning some steps of improvement inflammable process what there is asthma, particular attention should be paid to the improvement of living conditions and health situation of our society. Only under these conditions may the disease be optimally controlled with a proper quality assessment by patients.

Only this constituent of the asthmatic patient's welfare, disease control, may decide about the 'victory' over asthma.

Table I. Characteristics of the sample (n = 263)

	Cases	%
By sex		
Male	132	50,2
Female	131	49,8
By age		
<25	122	46,4
25-35	63	24
>35	78	29,7
By residence		
Urban>50th	108	41,1
Urban<50th	90	34,2

Rural	65	24,7
By smoking		
Never smoking	146	55,5
Former smoking	70	26,6
Current smoking	47	17,9
By education		
Primary	44	16,7
Secondary	164	62,4
Above secondary	55	20,9

Table II. Characteristics of the sample (n = 263) and their relationships to control of asthma /ACT/

	Control asthma by ACT						
	25		24-20		<20		p values
	Cases	%	Cases	%	Cases	%	
	83	31,6	119	45,2	61	23,2	
by sex							
male	39	29,5	58	43,9	35	26,5	p1=0,05
female	44	33,6	61	46,6	26	19,8	p2=0,26
by age (18-56)							
<25	45	36,9	55	45,1	22	18	p1<0,001
25-35	24	38,1	27	42,9	12	19	p2=0,30
>35	14	17,9	37	47,4	27	34,6	
by residence							
urban > 50 th..	49	45,4	47	43,5	12	11,1	p1<0,001
urban < 50 th.	23	25,6	51	56,7	16	17,8	p2=0,10
rural	11	16,9	21	32,3	33	50,8	
by smoking							
never smoking	59	40,4	59	40,4	28	19,2	p1<0,001
former smoking	16	22,9	38	54,3	16	22,9	p2=0,31
current smoker	8	17	22	46,8	17	36,2	
by education							
primary	9	20,5	18	40,9	17	38,6	p1=0,04
secondary	53	32,3	78	47,6	33	20,1	p2=0,55
above secondary	21	38,2	23	41,8	11	20	
	83	100	119	100	61	100	

Table III. Analysis of passive smoking and their relationships to control of asthma /ACT/

	Control asthma by ACT						
	25		24 - 20		<20		p values
	Cases	%	Cases	%	Cases	%	
Environmental tobacco smoking	51	61,4	81	68,1	45	73,8	p1=0,01 p2=0,80.
	83	100	119	100	61	100	

Table IV. Characteristics of the housing condition and their relationships to control of asthma /ACT/

	Control asthma by ACT						
	25		24-20		<20		p values
	Cases	%	Cases	%	Cases	%	
sunny flat	72	86,7	89	74,8	42	68,9	p1<0,001 p2<0,001
visible mould at home	5	6	11	9,2	9	14,8	p1<0,001 p2=0,02
damp spots on walls	8	9,6	15	12,6	11	18	p1<0,001 p2=0,02
discolours the wall after mould or moisture	3	3,6	9	7,6	8	13,1	p1=0,06 p2=0,75*
Cases of the earlier flat with the mould	12	14,5	22	18,5	19	31,1	p1=0,01 p2=0,02*
Removal of the earlier mould at the home	4	4,8	7	5,9	6	9,8	p1<0,001 p2=0,03
	83	100	119	100	61	100	

Table V. Analysis of environmental conditions and their relationships to control of asthma /ACT/

	Control asthma by ACT						
	25		24 -20		<20		p values
	Cases	%	Cases	%	Cases	%	
the thickens of flats							
>5 people	5	6	10	8,4	13	21,3	p1<0,001
3 to 5	31	37,3	56	47,1	21	34,4	p2<0,001
<3 people	47	56,6	53	44,5	27	44,3	
flat dry/damp							
	83	100	119	100	61	100	
dry	6	7,2	16	13,4	11	18	p1=0,001

damp	77	92,8	103	86,6	50	82	p2=0,005
Age of flat	83	100	119	100	61	100	
old>40 years	12	14,5	27	22,7	19	31,1	p1=0,03
new<40 years	71	85,5	92	77,3	42	68,9	p2=0,18
central heating							p1<0,001
	77	92,8	103	86,6	48	78,7	p2=0,04
Animals in the house (cat, dog)							p1=0,26
	29	34,9	52	43,7	33	54,1	p2=0,65
	83	100	119	100	61	100	

Chi-square with Yates's correction

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